LIBRARY OF THE NEW YORK BOTANICAL GARDEN

MEMOIRS
OF
THE NEW YORK BOTANICAL GARDEN

VOLUME 13, PART I

Atlas of North American Astragalus

R. C. BARNEBY

Issued 28 December 1964

The Memoirs of The New York Botanical Garden are published at irregular intervals in issues of various sizes. Approximately 500 pages will complete a volume. Standing orders for forthcoming issues should be placed with the Publications Office, The New York Botanical Garden, Bronx, New York 10458. Back issues should be ordered from Stechert-Hafner, 31 East 10th Street, New York, New York 10003.

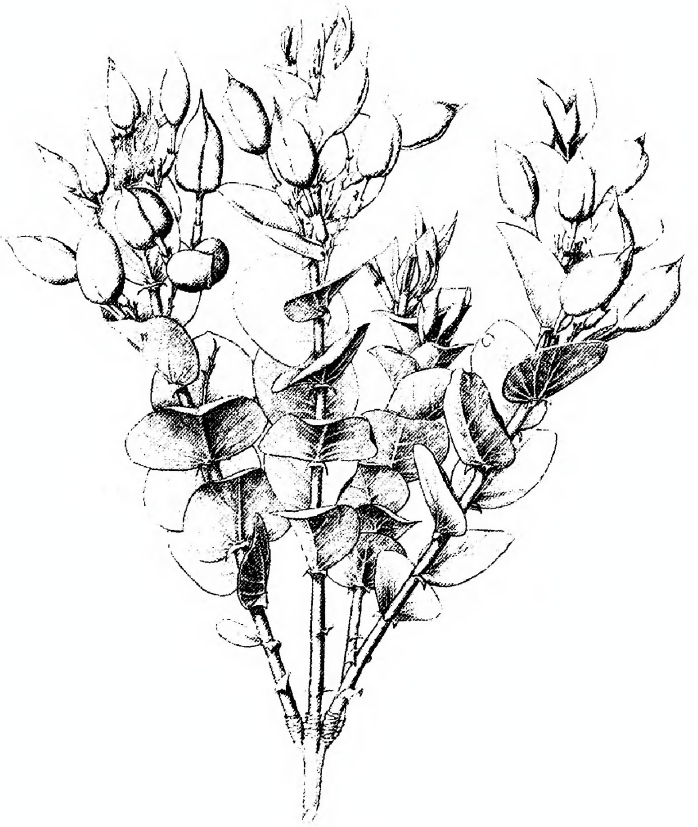
Authors of papers may obtain separate copies of their contributions at cost price, if they are printed at the same time as the issue.

Volume 13 is published in two parts of equal size and comprises 1200 pages. It is also available in a clothbound edition. Volume 11 is devoted entirely to the Manual of the Leafy Hepaticae of Latin America by Margaret H. Fulford. Part I has been published. Part II is in preparation. Volume 12 will be published in three issues. Number 1, Monographic Studies in Cassia. Section Xerocalyx by Howard Irwin has been published. Number 2, The Botany of Guayana Highland. VI, by Bassett Maguire and collaborators, is in preparation. Number 3, Supplementary Notes on the American Species of Strychnos. VII, by B. A. Krukoff is also in preparation. Volume 14 will also be published in three issues. Number 1, A Taxonomic Revision of the Genus Persea in the Western Hemisphere (Perseae-Lauraceae) by Lucille E. Kopp. Number 2, A Preliminary Account of the North American Species of Rhizopogon by Alexander H. Smith and S. M. Zeller. Number 3: Bromeliaceae of the Guayana Highland by Lyman Smith; Orchidaceae of the Guayana Highland by Charles Schweinfurth; Rutaceae of the Guayana Highland by Richard S. Cowan.

For further information address the editor:

Clark T. Rogerson
The New York Botanical Garden
Bronx, New York 10458

Atlas of North American Astragalus



Astragalus asclepiadoides

Memoirs of The New York Botanical Garden Vol. 13

ATLAS
of
NORTH AMERICAN
ASTRAGALUS

Part I

The PHACOID and HOMALOBOID
ASTRAGALI

by

RUPERT C. BARNEBY

1964

Table of Contents

Foreword i

Introduction

A Short History of the Genus 1

Morphology and Descriptive Terms 8

A New System for North American Astragalus 31

Introduction to the System 33

Synopsis of the North American Species 37

Systematic Treatment

Astragalus 53

Keys 55

Phalanx A. The Phacoid Astragali 91

Phalanx B. The Homaloboid Astragali 146

Phalanx C. The Cercidothrix Astragali 597

Phalanx D. The Hypoglottis Astragali 617

Phalanx E. The Piptoloboid Astragali 622

Phalanx F. The Trimeniaeus Astragali 1139

Phalanx G. The Orophaca Astragali 1143

Appendix I. Doubtful and Imperfectly Known Species 1156

Appendix II. Introduced Species 1158

Appendix III. Nomina Nuda 1164

Appendix IV. Species Excluded from the Genus 1165

Appendix V. Genera Excluded from North America 1167

Bibliography 1167

Index 1173

Copyright © 1964 The New York Botanical Garden, Bronx, N. Y. 10458

FOREWORD

It is now just one hundred years since Asa Gray completed the revision of North American *Astragalus* in which, by incorporation of the Linnaean *Phaca*, the genus assumed for the first time a comprehensive and rational form. The summary monographic studies of Marcus Eugene Jones (1923) and Per Axel Rydberg (1929) are between thirty and forty years old. However great their value, they are now dated, for much has been learned about *Astragalus* in North America during the intervening decades. Not only has a substantial number of new species come to light, but botanical explorers of the continent have brought together a quantity of material undreamed of only a few years ago. It is now possible as never before to assess the variation of the commoner species with some likelihood of completeness, and to determine with considerable accuracy their limits of dispersal. In fact, we possess evidence sufficient for the first time to form the basis of mature taxonomic judgments which may have some prospect of permanence. It is not suggested either that the Atlas is a complete census of our species, or that there is anything final about all taxonomic opinions expressed in it. On the contrary, local endemism being a feature of *Astragalus* as a genus, we can confidently expect the discovery of new forms, especially in Mexico and in intermountain United States; and it would be unrealistic to expect unanimous agreement with the taxonomic philosophy on which the Atlas rests. New facts, not to mention application of new or untried disciplines of inquiry to old ones, are bound to modify specific and racial concepts, and the present account of *Astragalus* in North America must be considered as an interim report, an attempt to summarize what has been learned about the genus during the century since Gray's classic memoir appeared.

The genus *Astragalus* has been a favorite subject of study and contemplation on my part for more than twenty years, and work in the field and herbarium leading toward the Atlas has been under way since 1942. During that time a detailed survey has been made of the deserts and interior plateaus of western United States, where the genus has one of its three focal points of greatest development, both in numbers and variety. A residence of several years in southern California, field trips to the Columbia Basin, the Rocky Mountains, southern Texas, southeastern United States, and New England, as well as traverses of the prairies at different latitudes and repeated visits to the summer-rainfall areas of Arizona and New Mexico, have furnished a background of familiarity with the living plants which alone illumines the herbarium record. The harvest of *Astragalus* material gathered on these journeys numbers about seventeen hundred separate collections and an estimated six thousand sheets of specimens.

The herbarium studies, which have gone hand in hand with exploration in the field, were concentrated on five collections, studied in close detail. These are the collections at The New York Botanical Garden, California Academy of Sciences, Pomona College, and Washington State College, and my private herbarium, now housed at Rancho Santa Ana Botanic Garden, where it is integrated with the collec-

tion of M. E. Jones. Many other herbaria have been consulted, in whole or in part, and with various degrees of concentration; a list of them accompanied by the traditional symbol used in citation follows herewith:

A	Arnold Arboretum, Cambridge
ARIZ	University of Arizona, Tucson
BKL	Brooklyn Botanic Garden, New York
BM	British Museum, London
BRY	Brigham Young University, Provo
CAS	California Academy of Sciences, San Francisco
DAO	Botany Laboratory, Dept. of Agriculture, Ottawa
DAV	University of California, Davis
DS	Dudley Herbarium, Stanford
F	Chicago Natural History Museum, Chicago
G	Conservatoire Botanique, Genève
GH	Gray Herbarium, Cambridge
ID	University of Idaho, Moscow
IDS	University of Idaho, Southern Branch, Pocatello
JEPS	Jepson Herbarium, Berkeley
K	Royal Botanic Gardens, Kew
LAM	Los Angeles County Museum, Los Angeles
LCU	Catholic University of America, Washington
LINN	The Linnaean Society, London
LY	Laboratoire de la Faculté des Sciences, Lyon
MICH	University of Michigan, Ann Arbor
MIN	University of Minnesota, Minneapolis
MO	Missouri Botanical Garden, St. Louis
ND	Herbarium Greeneanum, Notre Dame
NMC	New Mexico Agricultural College, Las Cruces
NY	The New York Botanical Garden, New York
OC	Oberlin College, Oberlin
OKLA	Oklahoma State University, Stillwater
ORE	University of Oregon, Eugene
OXF	Fielding Herbarium, Oxford
P	Muséum d'Histoire Naturelle, Paris
PH	Philadelphia Academy of Natural Sciences, Philadelphia
POM	Pomona College, Claremont
RENO	University of Nevada, Reno
RM	Rocky Mountain Herbarium, Laramie
RSA	Rancho Santa Ana Botanic Garden, Claremont
SBM	Santa Barbara Museum of Natural History, Santa Barbara
SD	San Diego Society of Natural History, San Diego
SMU	Southern Methodist University, Dallas
SRSC	Sul Ross State College, Alpine
TEX	University of Texas, Austin
UC	University of California, Berkeley
UNM	University of New Mexico, Albuquerque
US	National Museum, Smithsonian Institution, Washington
UTC	Intermountain Herbarium, Utah State College, Logan
WILLU	Peck Herbarium, Willamette University, Salem
WIS	University of Wisconsin, Madison
WS	Washington State College, Pullman
WTU	University of Washington, Seattle

The project of revising North American *Astragalus* could not have prospered without the aid received on all sides during the preparation of the Atlas. A complete list of friends, colleagues, and correspondents who have promoted the study with gifts and loans of herbarium material, with bibliographic and other technical advice, and with those intangible tokens of encouragement which are so important to all forms of human endeavor, would be inconveniently long. My gratitude and appreciation go out to all, especially to the curators and custodians of the herbaria listed

above. It would be churlish, however, to pass over without specific mention a few persons who either inadvertently (through innate generosity of spirit) or purposely have played decisive roles in the completion of the Atlas. I am especially indebted to: John Thomas Howell and the late Alice Eastwood, who devoted many pages of *Leaflets of Western Botany* to preliminary studies leading toward the present summary; Philip Alexander Munz, formerly curator of the Baker Herbarium, which contains the unmatched first set of Jones's *Astragali*; the late Ivan Murray Johnston, an authority on *Astragalus* in South America; Bassett Maguire and Arthur Cronquist, colleagues at The New York Botanical Garden; Noel Y. Sandwith of the Royal Herbarium at Kew; Dorothy Ebel Hansell, my gentle and resourceful editor; and Harry Dwight Dillon Ripley, without whose help in the field and financial assistance these pages could never have been written.

Note to the Reader

The taxonomic presentation in the Atlas follows a conventional pattern and requires only a few explanatory notes. The meaning of some special terms will be found in the section dealing with "Morphology and Descriptive Terms." The number in Arabic numerals following the description of each species or variety denotes the total number of collections studied in preparation of the text; that in small Roman numerals immediately following in parentheses denotes the number of these collections I made. The purpose of this breakdown is to indicate my relative familiarity with the taxon as a living organism. Descriptions of the plant-body up to the flower were compiled from dried specimens, using magnifications up to 20 diameters; those of the flower parts are taken from material either boiled or soaked in alcohol. It should be noted that the *Astragalus* petal ordinarily shrinks in drying up to 5–10% of its length when fresh, but is restored, completely or virtually so, by moistening. Even when due allowance is made for shrinkage, the banner, especially if greatly curved, can seldom be measured accurately in the dry state. Measurements of the petals, often of diagnostic importance, have been taken as follows:

The banner (vexillum) as though it were a simple, flat leaf, with the blade brought into the same plane as the claw and the margins laid out to their full capacity.

Wings (alae) and keel (carina) are measured first for their total length, following the natural curvature from base of claw to apex of blade; the claws are then measured separately from base up to the bottom of the sinus formed by the claw and the auricle of the blade. The wing-blade is measured along its natural curvature from tip of the reflexed auricle to apex of blade; the keel-blade directly from tip of the auricle to the furthest possible point, this sometimes coinciding with the petal's structural apex, sometimes with the outermost point on the petal's curvature. Curvature of the keel-petals is measured in degrees of divergence from the flower's vertical axis; it follows the blade's outer margin from the vertical of the claw to the point where the two petals become free from each other. A final outward curvature often observed just below the keel's structural tip is ignored for purposes of measurement, but in these instances the keel-tip is described as porrect.

Publication of this volume was financed by the
National Science Foundation under Grant GN-166.

The tendency in real life is always towa
greater and greater differentiation. . . .

F. Dostoievski: *The House of the Dea*

INTRODUCTION

A SHORT HISTORY OF THE GENUS

The recorded history of *Astragalus* goes back at least to Dioscorides, a contemporary (I century A.D.) of Pliny the Elder. The name itself is much older, being a word in classical Greek meaning ankle-bone, used in ancient times as a form of dice. It has been supposed that the word was applied to the plant, because the rattle of the seeds within the dry pods of some Mediterranean species, conceivably of *A. lusitanicus* Lamk., common in the Peloponnese, resembled the sound of dice in the thrower. This, however, is pure conjecture. As a generic name for milk-vetch, *Astragalus* was already familiar, as were its defunct rivals *Glaux* and *Cicer,* to western European botanists of the XVII century; but as a modern genus it may be said to date from Tournefort's *Institutiones Rei Herbariae* (p. 415, Tab. 233), published at the turn of the XVIII century (1700). Tournefort's *Astragalus* formed with *Tragacantha* and *Pelecinus* (the Linnaean *Biserrula*), both specialized members of the genus in its widest sense, a section of his Class X (= our *Papilionaceae*), separated from the remainder of the Bean Family by its siliqua bicapsularis or bilocular pod. Only one *Astragalus* with unilocular pod was known to Tournefort, the *A. lusitanicus* already mentioned, and this he placed next to *Galega,* along with the peas and vetches, in a separate section of *Papilionaceae,* calling it *Astragaloides,* "quasi planta ad Astragalum accedens."

The concept of a group of *Leguminosae* characterized by a bilocular legume has had a profound and lasting influence on the taxonomy of *Astragalus* and its close relatives. The systematic dichotomy initiated by Tournefort was confirmed by Linnaeus, whose genera *Astragalus* and *Phaca* are essentially the same as Tournefort's *Astragalus* and *Astragaloides,* even though the constituent species are not identical, and *Astragalus* L. included *Tragacantha* Tournef. If Tournefort had already implied a relationship between bilocular *Astragalus* and its unilocular mimic, Linnaeus proclaimed in his description of *Phaca* that since the pod of *Astragalus* was sometimes incompletely bilocular, a close relationship between the two genera could be assumed. Both in the Genera and the Species, Linnaeus placed *Astragalus* and *Phaca* in sequence among his *Diadelphia Decandria* (= Tournefort's Classis X), and the kinship between them has never been in doubt since. On the other hand, a controversy over the taxonomic status of *Phaca* and of other species-groups such as *Oxytropis* DC., which formed part of the inclusive Linnaean *Astragalus,* has been pursued with few interruptions since the time of Tournefort and even today provides a subject for discussion against a background of evolutionary theory. But before marshaling arguments for and against the dismemberment of *Astragalus* sens. lat., it will be well to look back over the taxonomic history.

The first naturalist to make a monographic study of *Astragalus* as a genus was Simon Peter Pallas. Under the auspices of Catherine the Great of Russia, Pallas traveled widely in central Asia and he was the first post-Linnaean botanist to describe any considerable number of *Astragali* from living specimens. In the introduction to his *Species Astragalorum* (1800), Pallas speaks of difficulty he had experienced in applying the Linnaean concepts of *Astragalus* and *Phaca* to his own discoveries. He referred with asperity to *Phaca* as a "factitious genus," yet he excluded from *Astragalus* the phacoid species characterized by a pod at once bladdery and unilocular on the curious grounds that the genus was already numer-

ically rich enough without them. Nevertheless Pallas introduced into *Astragalus* a certain number of species with unilocular pods, provided that these were small, as in some *Tragacanthae,* or falsely bilocular as in *Oxytropis,* where the so-called septum is in reality a funicular flange issuing from the ventral suture.

Each unaware of the other, DeCandolle and Pallas worked simultaneously on an account of *Astragalus* and related genera. Pallas was familiar with the species native to the Russian empire of that date and only treated those of Europe perfunctorily; DeCandolle had the rich resources of the Paris herbaria at his command, and his *Astragalogia* (1802) contains references to many *Astragali* unknown to Pallas, among them Levantine species collected by Tournefort and others and two found by Dombey in Peru. But DeCandolle knew many of Pallas's most interesting and suggestive Russian *Astragali* only from description, and thus the *Astragalogia* was to some extent provincial in its outlook even when published. Very possibly if DeCandolle had been able to study at first hand some of Pallas's more aberrant species, his views on the generic lines in the *Astragalanae* would have been modified. If he had known more species in the field, even among those close at hand in western Europe, he would have avoided some errors of observation, such as the supposedly resupinate pod of *Phaca.* In *Astragalogia* DeCandolle divided the Linnaean *Astragalus* into three genera: *Astragalus* sens. restr. characterized by an obtuse keel and a pod fully or semibilocular by inflexion of the dorsal suture; *Phaca* with obtuse keel and unilocular pod; and *Oxytropis* with acute or appendaged keel and a pod more or less bilocular by inversion of the ventral suture in the form of a funicular flange. In reality the pod of several Candollean *Phacae,* those now referred to *Astragalus* sect. *Hemiphragmium* and *A. alpinus,* have a narrow but incomplete septum arising from the dorsal suture exactly as in some members of *Astragalus* sens. restr., but this septum either escaped notice or was misinterpreted as an inwardly tumescent *ventral* suture become ostensibly dorsal by twisting of the stipe. Thus *Phaca* L. sensu DC., although characterized by an apparently strong morphological character, was based partly on a misapprehension, for some of its charter members demonstrate that transition between a genuinely unilocular and fully bilocular pod which Linnaeus had already noted. Moreover, *Phaca* sensu DC. was more heterogeneous in aspect than one would expect of a small natural group of species. As species were added subsequently, *Phaca* became a purely arbitrary category serving to accommodate *Astragali* in which the septum is weakly developed or actually obsolete. The history of *Phaca* is traced in more detail under the section of the same name (p. 91). DeCandolle's *Oxytropis* was founded principally on the apparently feeble character of an appendaged keel, but time has shown it to exist as a large natural group, whatever taxonomic rank is assigned to it; and it has remained in good repute, either as an independent genus or as a subgenus of *Astragalus,* until the present day. Its history has been recounted elsewhere (Barneby, 1952), but its relationships are discussed below in connection with a phylogenetic scheme for the *Astragalanae.* Looking back, one might say that both *Phaca* and *Oxytropis,* although far from equal in quality or taxonomic worth, owe their longevity in the literature as much to the prestige of DeCandolle as to any merit they possess as genera distinct from *Astragalus.* But it is only fair to bear in mind that they were founded on data derived from less than two hundred species, a fraction of those now known to exist, and were established in the traditions of European botany, especially by their elaboration in DeCandolle's *Prodromus* in 1825, before the great reservoirs of astragaline variation in western North and South America had been sampled.

The genus *Astragalus* was, of course, known to exist in America even in pre-Linnaean times. A species described by Tournefort in 1700 as *A. Canadensis, flore*

viridi, flavescente, had been mentioned by Dodart as early as 1676, when it was already cultivated in the Jardin du Roi in Paris. In 1732 Dillenius described an *Astragalus* grown in England from seed collected by Catesby in Carolina, and these two species, under the names *A. canadensis* and *A. carolinianus,* are part of *Astragalus* as formulated by Linnaeus in 1753. They were indeed the only species from North America known to DeCandolle when he published *Astragalogia* fifty years later. It is thus only with the turn of the century and the publication of Michaux's Flora in 1803 that the processes of discovery and description of our species can be said to have begun in earnest. Michaux added to the pair known previously three *Astragali* from the eastern seaboard: *A. secundus* (= *A. alpinus* var. *Brunetianus*) from Quebec, and *A. villosus* and *A. glaber* (= *A. Michauxii*) from the Carolinas. In 1815 the remarkable *A. radicans,* a species narrowly endemic to low-lying meadows in the Valley of Mexico, was described from plants in the Copenhagen Botanic Garden grown from seed collected by Humboldt and Bonpland; and a second Mexican member of the genus, introduced perhaps by the same collectors (but possibly much earlier, by Sessé and Mociño), had been described the previous year as *A. micranthus* Desv. from plants cultivated in Paris. The first *Astragali* from western United States also date back to the year 1814: to *Phaca densifolia* (= *A. Nuttallii*) found at Monterey, California, and grown in English gardens, and the four species brought back from the plains of the Missouri by Lewis and Clark and by Bradbury and worked out by Pursh for his *Flora Americae Septentrionalis.* After Pursh the census of known species swelled rapidly as the pioneer naturalists began to sample the botanical riches of the continent's interior. Nothing could be gained by an exact chronological record, species by species, and we must pass lightly over Nuttall's Genera (1818), Richardson's *Botany of the Franklin Expedition* (1823), Humboldt's *Nova Genera* (1824), and pause briefly to consider the first systematic landmark in the literature of New World *Astragalus,* Hooker's treatment of that genus and of *Phaca* in *Flora Boreali-Americana* (1831). In this important work, a summary of what was known of the higher plants of Canada and United States at that time, Hooker listed 29 species, of which 18 were described for the first time, principally from material brought back from the Columbia Basin and from the Canadian Rocky Mountains and prairies by Douglas and by Drummond. Hooker followed so far as was possible the Candollean concept of *Astragalus* and *Phaca* laid down in *Astragalogia* and the *Prodromus,* although there were already signs that the American species would pose a threat to the stability of these genera, defined hitherto in terms of groups native to the Old World. Closely following Hooker's Flora appeared the yet more momentous account of *Phaca, Astragalus,* and Nuttall's new genera *Homalobus* and *Kentrophyta* in Torrey & Gray's *Flora of North America* (1838). With this volume the roster of North American species rose to 83, over half of which were newly described, 34 of them from material collected by Nuttall on his transcontinental journey with Wyeth and later on the California coast.

Torrey & Gray's Flora marked a turning point in American systematic botany, up to that time the province of savants in western Europe, but from now on to be dominated by native Americans. In Europe the word of DeCandolle might be revered as canonical, but on the expanding frontier of a new country it had to face the test of unforeseen discoveries and was sometimes found wanting. Thus Nuttall's new *Astragali* with pods laterally compressed and two-sided like that of *Ervum* or *Vicia,* or pods lentiform and unilocular combined with prickly foliage, or others (doubtfully referred to *Phaca*) with trifoliolate leaflets gathered into a stemless tuft, required categories not provided in the *Prodromus.* For the time being Torrey & Gray arranged all the species with bilocular fruits in *Astragalus* proper, which they

divided into three arbitrary groups characterized by features of the stipule and by color of the petals, and accepted *Phaca* in the Candollean sense for the species with unilocular or subunilocular pods not greatly compressed laterally; the residue of unilocular species formed the genus *Homalobus*. The discovery of new unilocular types, which are far more numerous in America than in Europe, rendered *Phaca* as enlarged by Torrey & Gray even more heterogeneous than it had been at the hands of DeCandolle. The groundwork had been laid for a complete reappraisal of generic concepts.

From the Flora of Torrey & Gray we pass directly to Gray's *Revision of the North American Species of Astragalus and Oxytropis* (1864), the foundation upon which the modern taxonomic edifice arose. It was in this paper that Gray demonstrated that the old distinction between an unilocular (or subunilocular) *Phaca* and a bilocular *Astragalus* had broken down completely in America, and that these genera, however distinct they might have appeared in Europe, were morphologically confluent in the New World. As an alternative to combining the two old Linnaean (really pre-Linnaean) genera that DeCandolle had maintained in a modified and enlarged form, Gray envisaged the possibility of further generic segregation based on other carpological characters. But he foresaw that the American species known at that time, to the number of 111, would alone require twenty such groups, even less easily defined than *Phaca* and *Astragalus*. It is interesting to find that when Rydberg undertook the generic segregation of the American species he ended with twenty-eight genera, as poorly defined as Gray foretold. Characters of the fruit were used by Gray to distinguish twenty-seven (the number is a coincidence) sections which he arranged in sequence starting from the fully bilocular, broadly septate *Sarcocarpi* and passing through the subbilocular series into the phacoid or homaloboid, truly unilocular groups. Gray also employed in his key to the sections secondary characters such as the union of the stipules and, in a few cases, size of the flowers and color of the petals, but he placed greatest emphasis on the fruit, thereby determining the direction that the systematics of *Astragalus* would take in America for nearly a hundred years.

In the meantime botanical exploration of the Orient, especially Turkey and Iran, of central and eastern Asia, of the Himalaya, and of North Africa had by 1850 approximately trebled the number of species known to DeCandolle in 1802; and at the appearance of Gray's Revision of the American *Astragali* in 1864, Alexander von Bunge was already well advanced on a greatly needed monograph of the genus in the Old World. His *Species Gerontogeae* was published in two parts in the years 1868 and 1869, raising the known total outside America to an imposing 971, about a fourth of them newly described. Bunge adopted Gray's definition of *Astragalus,* even attributing the genus to his transatlantic colleague rather than to Linnaeus or Tournefort, and reduced *Phaca* to a subgenus characterized no longer by an unilocular pod but by a loosely racemose (rarely axillary or subradical) inflorescence. His classification involved the recognition of 8 subgenera and 105 sections defined in terms of characters offered by the stipules, leaves, vesture, calyx, and petals. It was an entirely novel system, and although the resulting arrangement of species is sometimes artificial, it was adopted with only minor changes by Boissier in *Flora Orientalis* (1872) and has been employed successfully in most modern treatments of the genus in Europe and Asia. The carpological characters that Gray found useful in definition of whole groups of species were employed by Bunge only to differentiate between species within the group, and from the points of departure of Gray's and Bunge's monographs the systematics of *Astragalus* in the New and Old Worlds have developed along divergent paths. With Gray's successors the emphasis has always been on the pod and its qualities of texture, compression, and

introflexion as a septum, whereas the leaf, stipule, flower, trichome, and duration of the root have received the chief attention in Eurasia. The only attempt at a census of the genus on a world-wide basis since Bunge's monograph is that of Taubert in Engler's *Pflanzenfamilien* where the Old World, North American, and South American *Astragali* are treated as completely separate subjects, even though there are some groups of species common to North America and Asia and others common to North and South America.

For a few years after his Revision was published, Gray continued to describe novelties in the genus; but as he became increasingly absorbed in study of the sympetalous orders leading to the *Synoptical Flora of North America,* the care and identification of *Leguminosae* at Harvard passed into the capable hands of Sereno Watson and continued there until his death in 1892. As botanist to Lieut. King's Exploration of the Fortieth Parallel, Watson had spent two seasons collecting in Nevada, Utah, and southwest Montana and had become the first botanist since Nuttall to describe any considerable number of *Astragali* from self-collected specimens. His synopsis of the American species in King's Report (1871) is, however, not of great historical importance, being little more than a revised version of Gray's system with additions to date. His list comprises 128 species, 19 of them new.

The year 1891 saw the publication of Otto Kunze's *Revisio Generum,* and 1893 that of the first volume of *Index Kewensis*; it is fair to ascribe to these two important books most of what was novel or permanent in the next comprehensive study of our plants, E. P. Sheldon's Preliminary List of 1894. At the time this synopsis of the genus was in preparation, the author was in his early twenties and not equipped by experience to handle a group of such size or complexity. Nevertheless his substitution of new epithets for those shown (sometimes incorrectly) by *Index Kewensis* to be later homonyms has left a lasting imprint on the nomenclature, and Sheldon did describe among many which have fallen into disrepute some genuinely distinct novelties. The List is of no systematic importance. It might be described as an often inept elaboration of Gray's Revision, with many of the species described since 1864 altogether misinterpreted and introduced at inappropriate places. A spurious air of novelty was achieved through alteration of Gray's sectional names, which were formed as adjectival plurals, into a singular substantive form. The few altogether new sectional names proposed by Sheldon lack accompanying descriptions and are properly ignored as nomina nuda. The Preliminary List embraces 313 species including those enumerated as obscure or of unknown affinity.

At the time Sheldon's attempt at a revision made its appearance, two new students of *Astragalus* in America were beginning to make their mark on the genus. Marcus Eugene Jones had, in fact, already done so in the first of his serial *Contributions to Western Botany,* of which the early numbers were published in the pages of *Zoë* starting in 1891. In the nineties Jones lived in Salt Lake City, at the hub of one of the great centers of *Astragalus* speciation, and his explorations of the Colorado Plateau and the Great Basin had begun to turn up the most striking and highly modified forms. Jones tells us (1923, p. 17) that it was the inadequacy of Sheldon's List which prompted him to undertake a monograph of the subject, and work toward a revision started in 1895. From interior evidence in the Contributions we learn that he had made a detailed study of the *Astragalus* collection at California Academy of Sciences as early as 1893, and he had had access to Mr. and Mrs. Brandegee's private collection at about the same time. By 1895 he had examined the material at the Smithsonian (US), and either the same year or shortly afterward the *Astragali* at Harvard (GH) and Columbia (NY) Universities. By 1898 he claimed (Contrib. West. Bot. 8: 3) that he had seen (and incidentally photo-

graphed) the types of nearly all North American *Astragali,* although it should be noted that this does not include any preserved in European herbaria. I am not sure when the Revision was finished. It seems to have reached a state of near completion about 1910 and was scarcely modified subsequently, but there were difficulties in finding a publisher and its appearance was long delayed. The text was finally set up in type by Jones himself, run off on a hand press, and distributed on February 15, 1923, the plates following in June of the same year.

Jones's Revision initiated a new era in the systematics of *Astragalus,* an era in which a search for natural evolutionary relationships between species and between groups of species began to replace emphasis on similarities in a small, arbitrarily chosen set of morphological characters. The book is full of invaluable information and insights, but is nevertheless an exasperating work. To the novice in *Astragalus* the book is impenetrable, because the path to a given species lies through a labyrinth of polychotomous keys, an invention of which the author was inexplicably proud; but to the advanced student who has learned "where to look," it is richly rewarding. In his day Jones knew more about *Astragalus* than anyone alive, but a volatile impatience with details of presentation tends to obscure that fact. The Revision contains some errors of observation, but its defects are largely superficial ones of organization and deployment. It is fair, however, to criticize Jones for his contemptuous treatment of contemporary botanists, particularly of Rydberg and of Wooton and Standley, who dared to trespass into his chosen field of inquiry. Moreover he seems to have believed, quite genuinely, that he had found every existing *Astragalus* species native from the Rocky Mountains westward, and that descriptions of new entities proposed by others were either fatuous or mischievous fabrications. Against these very human imperfections, symptomatic of a forceful and choleric personality, we must contrast Jones's sane and mature concept of species, at which he arrived through years of familiarity with the growing plants, their ecology and dispersal, and imponderable attributes grasped more intuitively than by conscious observation. Traveling as he did year after year, afoot or with only a burro or bicycle for transport, through the vast empty landscapes of the West, Jones came to know his species in a way that is impossible for a museum botanist. His opinions on *Astragalus,* as formulated in the Revision, have almost all been vindicated by subsequent scrutiny. Jones's sections in the genus and his views of kinship among them are less sound; they are discussed further below under the heading of "Phylogeny." The Revision portrays the genus in America as comprising 30 sections, many of them further subdivided in species-groups or subsections, and 273 species with 144 subordinated varieties. The total of 417 specific and infraspecific taxa implies a gain of almost ninety entities over those known to Sheldon in 1894.

The second young botanist working with *Astragalus* in 1894 was Per Axel Rydberg, then at Lincoln, Nebraska, engaged in a revision of the *Leguminosae* for the Nebraska State Flora. His account of *Astragalus,* conservative and traditional in outlook, appeared in 1895 and was the first of a long series of papers, devoted wholly or in part to the taxonomy of the genus, which culminated in his summary monograph for *North American Flora* (1929). It is the fashion nowadays, I think, to underestimate Rydberg's ability and to belittle his achievement. His narrow and severely technical concept of genus and species is at the opposite pole from the modern view based on evolutionary and genetic principles. But Rydberg, too, had his principles, and they were firmly based on logic. Toward the end of his career, when his method became the target of widespread criticism, he published a witty and urbane apologia pro vita sua, which is a confession of faith, in no sense dogmatic, and completely disarming. It is titled "Scylla and Charybdis" (Proc. Inter-

nat. Cong. Pl. Sci. 2: 1539–1551. 1929), in reference to the splitter's rock and the lumper's whirlpool, those twin perils that lie in wait for each navigator through the strait of taxonomic botany. Reading it one becomes aware that Rydberg was committed to binomial nomenclature in a passionate and absolute manner and that he saw the recognition of infraspecific categories, especially when carried out as in Germany into an elaborate hierarchy, as in effect a step on the road back to pre-Linnaean polynomialism. Furthermore, he made a valuable distinction between the disciplines of taxonomy and nomenclature: the latter is a method of labeling and provides a means of reference, whereas the former involves the recognition and definition of self-perpetuating entities and of their origins and relationships. There is an exploratory phase in the description of all floras when taxonomy, strictly speaking, is hardly possible, and Rydberg presided over that period in the botanical history of intermountain and Rocky Mountain United States, the parts of North America where *Astragalus* is most highly developed. Rydberg's Floras and revisions of genera are in reality little more than illustrated catalogs, and for this purpose the binomial was the handiest possible label. It should never be supposed that Rydberg was unaware of the protean aspects of the species or of the controversial nature of the term itself. When it came to observing small anatomical differences in plant specimens, Rydberg had few peers; perhaps too often he was inclined to leave to a succeeding generation the responsibility for assessing the meaning and value of the characters observed.

Rydberg's activities in the field of generic and familial segregation, which call for mature taxonomic judgment, are, on the whole, less praiseworthy. His segregate genera are logical propositions, but the logic proceeds too often from a false premise, and his view of generic problems is sometimes provincial in outlook. In the taxonomy of the *Leguminosae* structure of the pod is of obvious value at the level of the genus, but this is only so where the elaboration of the genus into its component species occurred after the pattern of the fruit had become more or less fixed. In some groups of *Leguminosae,* such as *Medicago,* or *Trigonella,* or especially *Astragalus* sens. lat., the pod evidently continued to evolve pari passu with the species subsequent to the establishment of the genus. Rydberg was blind to this important difference; and once embarked on a policy of distinguishing between phacoid, homaloboid, and genuine astragaloid types of legume, he was compelled by logic and a sense of consistency to pursue the fragmentation of *Astragalus* to the absurd end foreseen by Gray in 1864.

The summary monograph in *North American Flora* (Rydberg, 1929) differs in substance so greatly from Jones's Revision, published only six years earlier, that they provide, at least upon superficial comparison, a valid example of what has been stigmatized as subjective, therefore "unscientific," taxonomy. But when used together the two treatises are complementary, the defects of one being largely set off by the virtues of the other. Where Jones was expansive, dogmatic, and diffuse, Rydberg was dryly analytical, modest, and precise. Whereas Jones scornfully jettisoned as absurd or impossible everything which had not fallen under his direct observation, Rydberg was meticulous, sometimes excessively so, in preserving and acknowledging the work of others. But beyond all this there was a fundamental difference in the two men's approaches to plants and botany. Jones was above everything else a field botanist, alive to the influences of geology and climate on the dispersal and evolution of species, but he was not greatly gifted in the techniques and disciplines of a museum worker. Rydberg was in the first place a scholar in the European tradition, and he had comparatively limited interest in or experience with living plants. In contrast to Jones's lifetime in the field at all seasons of the year, Rydberg's experience in western United States was limited to half a dozen forays,

mostly undertaken in summer and therefore at montane altitudes where *Astragalus* is not very highly developed. On the other hand, Rydberg had access to libraries and herbaria of a size and completeness almost unknown to Jones.

The most serious defects of Rydberg's monograph become apparent only upon use. The keys, although of an enviable clarity and concision, are often keys to idealized abstractions which have little application to living organisms. The key to the genera (1929, p. 251), which pretends to discriminate between 30 genera by means of only 34 dichotomies, admits only one or two of many exceptions implicit in the descriptive text which follows; its austere simplicity is no match for the complex realities to which it appears but fails to introduce the reader. The specific keys, likewise, are often little more than keys to type-specimens. The descriptions are admirable for their consistent format, which facilitates comparisons, but they are too often formulae based on study of one or two specimens (with emphasis on the sometimes atypical typus) and seldom do justice to all the specimens annotated by Rydberg and stamped as "examined for *North American Flora.*" The indications of range, especially in the case of species already known to be extremely local, are regrettably generalized. Nevertheless, despite its faults, Rydberg's monograph has served for thirty years as the indispensable text dealing with North American *Astragalus*. Within the limits of the genus as treated here, Rydberg recognized 28 genera and 564 species, nearly 150 more taxa than described by Jones. Of the 130 *Astragali* described (in various genera) by Rydberg during his lifetime, I have been compelled to reduce 80 to synonymy, and of the surviving 38% much more than half are degraded to varietal rank. By contrast, Jones described altogether 150-odd *Astragali,* either as species or varieties; of these 63 appear below as synonyms, but much more than half of the remaining 60% are retained in their original category.

The taxonomic history of *Astragalus* in North America can be summarized numerically by tabulating the number of species, varieties, and other categories accepted by the five principal monographers of the genus in the last hundred years:

Author (date)	Genera	Subgenera	Sections	Species	Varieties	Species + Varieties
Gray (1864)	1	2	27	111	4	115
Sheldon (1894)	1	2	30	313	17	330
Jones (1923)	1	0	30	273	144	417
Rydberg (1929)	28	3	82	564	0	564
Barneby (1964)	1	0	93	368	184	552

MORPHOLOGY AND DESCRIPTIVE TERMS

The North American *Astragali* are annual and herbaceous, or less often subshrubby perennial herbs which display a wonderful variety in habit of growth, stature, and general appearance. The annuals possess a simple taproot and one or commonly several developed stems arising from axils immediately following the cotyledons. Their seeds germinate either in spring or fall, according to the species or its particular environment. The life-cycle of the vernal species is ordinarily completed within three or four months. The perennials, more numerous by far, are phanerophytes, chamaephytes, and hemicryptophytes, depending on whether the year's stems regenerate from points above, at, or below the level of the soil. The position of the resting buds or points of renewal is in nearly all cases characteristic of a species, generally so of whole groups of related species. Occasionally the caudex (defined below) elongates over a period of years, but the North American *Astragali* are never genuinely shrubby like the Old World *Tragacanthae*. Stemless and almost stemless species are numerous, assuming simple rosette or sometimes ela-

borately ramified mat and cushion forms. Rarely the stems arise singly from creeping rhizome-like structures, a modified form of subterranean caudex.

Root

The simple taproot is the basic type throughout the genus, and it is subject to little modification, although it varies enormously in length and thickness depending on the species and the individual plant. In dry and porous soils the taproot plunges deeply before setting forth lateral feeding rootlets; in moister and heavier soils more numerous secondary roots are encouraged, and these arise more shortly below the often considerably thickened or knotty root-crown. I know of no example of a truly fibrous root-system, although on occasion the lateral roots may become nearly as thick as the central taproot. Adventitious roots from the caudex are mentioned in the next paragraph. In *A. radicans* adventitious roots arise from leaf-axils of prostrate stems.

Caudex

The caudex consists of stem-bases which give rise to the herbaceous growth of the second or following seasons. It is found in three positions: above, at, and below soil-level; and the three types can be differentiated as aerial, superficial, or subterranean. In many *Astragali* the caudex is condensed and reduced to a knotty root-crown or turbinately enlarged platform at the head of the root. In others, especially the acaulescent species, the caudex-branches are closely beset with a thatch of marcescent, scaly stipules and leaf-bases, which may take the form of a protective collar about the resting bud or in the pulvinate species that of a gradually elongating column. Branches of an aerial caudex either hug the ground or, more frequently, ascend weakly or strictly, in some cases ramifying into a bushy tangle. The aerial caudex usually is best developed under mild and dry climatic conditions, especially in regions free from heavy snowfall; the majority of montane and boreal *Astragali* are cryptophytes. In some species, and even in some groups of species, a subterranean caudex is modified into a set of rhizome-like branches radiating from the buried root-crown. These subterranean organs are easily distinguished from roots by the presence of well-defined nodes, often marked by stipular sheaths or their remains. They may be simple and of no great length, each giving rise to one or more herbaceous stems from a terminal point, or they may become greatly elongated (when either simple or ramified) and give rise to stems at intervals along their whole length. Species characterized by an extensively developed subterranean caudex are often described as rhizomatous; single plants of them appear to form colonies of separated, often solitary stems. Nodes of a buried caudex-branch sometimes may give rise to adventitious roots, of which a few may eventually assume the function of a taproot and establish an independent organism by vegetative reproduction. In mild climates, such as prevail along the California coast, herbaceous plants can remain active almost throughout the year granted sufficient moisture. In this region the stems of some *Astragali* gradually become indurated toward the base, and old plants assume an almost bushy habit of growth. The indurated base does not become really woody but is nevertheless a modified form of caudex.

Vesture

With few exceptions the plant-body of all *Astragali* is beset with at least some and ordinarily many hairs; these are extremely variable in quality, length, and mode of attachment, but generally compose a vesture characteristic of the species. The hairs tends to be most closely set in the inflorescence and more sparsely so on leaves and stems. They are ordinarily more abundant on the lower surface of the leaflets, rarely so on the upper. All *Astragalus* trichomes are unicellular, if we ignore the

one or two small cells sunk in the epidermis which form their platform of attachment. They vary from extremely fine, elongated, and flexible, to short and rigid. Not infrequently the short hairs become dorsiventrally flattened and scalelike. They may be straight, simply incurved, sinuous, or curly; when both long and straight, they are often spirally twisted. They may be truly appressed or ascend at increasingly wide angles; retrorse hairs are extremely rare but not unknown. Their exterior surface may be smooth and lustrous, smooth but dull, or beset with minute granules of carbonate of lime and microscopically scabrous in consequence. Very commonly on the inflorescence and sometimes also (or independently) on the leaf-rachis, stipules, or elsewhere, some or most hairs are stained with a fuscous or black pigment. Color of the hairs is seldom constant within a species and is not correlated with the presence of anthocyanin in the corolla. The attachment of the hairs may be either basal or lateral. A basifixed or simple hair is commonly broadest near the base and tapers gradually upward. A laterally attached hair is termed *dolabriform* (pick-shaped, malpighian or malpighiaceous, pili mediofixi, and poils en fausse navette are other terms) and consists of an ascending and a nearly always shorter descending arm. It is broadest near the point of attachment and tapers toward either end. Dolabriform hairs are usually straight and strictly appressed, with the two arms opposed in the same plane; rarely one or both arms become flexible or curly. Dolabriform vesture is characteristic of many groups of species, of innumerable species, and even of some varieties within the species. It is an extremely valuable taxonomic character. However, even when all or most hairs on the herbage of a given *Astragalus* may be dolabriform, a few basifixed hairs can generally be found on the margins of the bracts or stipules; and in some species, hairs of both sorts commonly occur on the same leaflet. Hairs of intermediate character, affixed laterally at base or provided at base with a minute, retrorsely directed boss or incipient lower arm, are frequently observed. Typical dolabriform hairs have been illustrated by Kearney (in Leafl. West. Bot. 4: 223. 1946), by Briquet (Prod. Fl. Corse 2: 348. 1913), and in many dictionaries of plant morphology.

The nature of the *Astragalus* hair can be observed with ease under a magnification of ten diameters. A dolabriform hair touched by a needle pivots around its point of attachment, whereas the basifixed one rotates on its base. A dry leaflet, broken in half, appears ciliate along both lines of fracture if the vesture is dolabriform and ciliate along the broken edge of the lower segment only when the hairs are basifixed. Except when the descending arm of the hair is very short, it can be seen in this way by the naked eye.

The terms used in botanical literature to describe diverse types and qualities of pubescence are employed even by contemporary authors in different contexts and have sometimes altered their meaning over a period of years. It has always been difficult to assemble an objective vocabulary descriptive of vesture because of the insensible transitions from one type of hair to another. Pubescence offers important and highly serviceable criteria in the taxonomy of *Astragalus,* and as it is repeatedly mentioned in the Atlas, a short glossary of terms employed will be helpful.

Strigose = straight, appressed, relatively rigid. The term is often qualified, as: finely strigose, when the hairs are filiform, or loosely strigose, when not truly appressed.

Incumbent = ascending and upwardly incurved.

Villous = ascending, spreading at a wide angle, or subhorizontal, but in any case fine and flexible; villous hairs may be either straight or sinuous.

Hirsute = spreading and relatively coarse, straight or nearly so.

Tomentose = fine, closely set, curly and entangled.

These principal terms are used arbitrarily for hairs over 1 mm. long. When the longest hairs are less than 1 mm. long the corresponding diminutive (strigulose, villosulous, etc.) are appropriate. In addition the main terms are further qualified, generally in a self-explanatory

way, in special cases, e.g.: cottony-tomentulose, indicating a shortly tomentose vesture of non-lustrous hairs; or satiny-strigose, conveying the silvery sheen of a dense, appressed pubescence of smooth, straight hairs. The pubescence is often composed of two types of hairs intermixed and can be described only in compound terms, e.g.: hirsute-tomentulose or hirsutulous-tomentose, indicating a mixture of stiffly spreading and curly hairs of different lengths, the curly ones shortest in the first instance and longest in the second. Special conditions have sometimes dictated the use of special, self-explanatory terms.

Stem

The commonest type of stem is essentially simple and bears an indefinite but small number of axillary racemes above the middle. Slender stems are solid or nearly so, whereas robust ones are composed of hollow internodes. Ordinarily the main axis becomes abruptly more slender beyond the last peduncle, or even abruptly inhibited when the last inflorescence appears pseudoterminal. In a few *Sarcocarpi* and members of some other groups the racemes at anthesis are situated well above the middle of the stem, but this continues to elongate while the fruit ripens and the pods are thus concealed by ample foliage. Commonly sterile spurs or branchlets are borne at one or more nodes preceding the first peduncle, or near the base of the main stem so as to form a leafy tuft; more rarely lateral branches bear flowers or are further ramified. In some mat-forming *Astragali* branching proceeds indefinitely, and the extremities are almost all fertile. In a very few species the first leaf and internode of all (or some) branches is suppressed. As a result one finds an apparently naked peduncle inserted between the branch and the main stem, or a branch and branchlet paired in the same manner, or distally a vigorous peduncle paired with a depauperate one in the same axil with no leaf or stem intervening. In many *Astragali* the internodes are all suppressed and the plants reduced to rosette form, consisting of one or more short cylindric axes concealed by closely imbricated stipules. Acaulescent plants of this type have essentially scapose peduncles sometimes so far contracted as to bring the flowers down into small clusters sessile among the tufted leaves.

Stipules

In its simplest form the stipule is a triangular or lanceolate structure arising from the stem at base of the petiole on either side. In *Astragalus* the pairs are mutually symmetrical and vary in texture from foliaceous to papery, quite often becoming scarious or even hyaline. The lowest, especially, often change in texture from herbaceous to papery as the season advances, and occasionally they become fragile and deciduous, leaving a stipular scar. The stipules may be nerveless (or apparently so), prominently three-nerved, or less often several-nerved through ramification of the three primary veins. When three nerves are present, the vascular bundle adjacent to the petiole forks at base of the stipule, one branch leading to the petiole itself, the other into the stipule, whereas the two others remain simple. The base of the stipule-pair embraces anything from one-fourth to the whole of the stem's circumference. Both may be inserted horizontally on the stem or obliquely, when the contrapetiolar corner becomes more or less decurrent on the stem. When fully amplexicaul the contrapetiolar margins often become fused for part of their length, when they are called *connate*. The relative length of the amplexicaul sheath and the free blades beyond the point of fusion varies with the species and with the position of the stipules on the stem. In some species connate stipules are found normally at all nodes, in others at the lower nodes only, in some at nodes only below ground; but in nearly all cases stipules nearer the ground or produced earlier in the year's growth-cycle are more strongly united than distal or later ones. In the case of exceptionally vigorous individual plants or characteristically in the case of some robust species, the stipular sheath is ruptured by expansion of the stem and can be

observed only in young specimens or late in the season only low on the more slender branches. Partially amplexicaul stipules are termed *free,* though they are often united for a short distance to the petiole-base. The union of stipule and petiole is never so marked in North American *Astragalus* as it is in most species of *Oxytropis* or as in the so-called podochreate *Astragali* of Asia. In a few species the stipules at some of the lowest leafless nodes are partially (in sect. *Phaca* fully) joined together on the side corresponding to the suppressed petiole, forming a bidentate structure (in *Phaca* an entire blade) easily mistaken for a truly amplexicaul sheath. The margins of the stipules are commonly ciliate, and some hairs are often shortened and thickened into the form of small tack-shaped or peglike structures with the exterior appearance of stipitate or clavate glands. The development of these specialized trichomes is very uncertain within the species.

Leaves

The leaf in *Astragalus* is prevailingly of the imparipinnate type common in the Bean Family and consists of an indefinite number of petiolulate, exstipellate leaflets varying from linear-filiform to broader than long. In some species the leaflets are sessile but jointed to the common rachis; these commonly disjoint in age, leaving a small pitted scar. The petiolule when present may appear consubstantial with the leaflet, but is more often of a more transparent texture and commonly of a paler (yellowish) color; in this genus it is never thickened and never pubescent. A modification of the leaflets common in North America arises from simultaneous suppression of the petiolule and of the joint. Such leaflets, usually of a linear-elliptic or linear type, are termed *confluent*; they may be terminal only, or both terminal and lateral. When terminal they sometimes simulate a rachis produced beyond the last pair of leaflets in a paripinnate leaf. The leaflets are sometimes pinnately veined, but the venation is usually immersed and becomes visible externally only in broad leaflets of membranous texture, such as one associates with a woodland or streamside habitat. The midrib is generally well defined and is sometimes thickened and elevated on the lower side of the leaflets; in a few species it runs out at apex into a mucro or spinulose point. In North America we have only one species, *A. Kentrophyta,* in which the foliage becomes rigid and prickly.

On the American continent the leaflets of fully developed leaves fluctuate in number around a mean of about twenty-one. In general the fewer the leaflets the more nearly constant is the number within the species, but early leaves always tend to be simpler than later ones, and the first one or two succeeding the cotyledons are often only unifoliate or trifoliolate. Leaflets in the normal leaf are usually disposed in opposite pairs along the rachis, but are often more or less scattered. They tend to diminish in size upward, but the terminal one is often longer than the contiguous pair. In a few species the leaflets are reduced to five, three, or even a single one, but the palmately trifoliolate leaf of sect. *Orophaca,* for example, is clearly a modification of the primordial pinnate type. In some xerophytic *Astragali* the lateral leaflets, especially those of the decurrent type, become greatly reduced in size, number, or both at once, in all or at least some of the upper leaves. In several the lateral leaflets are suppressed, reducing the leaf to a filiform rachis, often slightly dilated at tip. Species of this sort assume a rushlike or scoparious habit and are often switch-plants associated with dunes or desert sands. Rarely the loss of leaflets coincides with dilation of the rachis (or rachis and petiole together), which thereby comes to resemble a simple leaf of grasslike outline. Modified leaves of this type are termed *phyllodia.* In the extraordinary *A. asclepiadoides* the leaves consist of simple, sessile, obcordate or suborbicular blades of large size and leathery texture; apparently they

represent the terminal leaflet enormously developed at the expense of rachis and lateral leaflets, both of which have disappeared.

For convenience of reference the midrib of the whole leaf, at least when provided with leaflets, is considered as differentiated into petiole and rachis, the former being the part below and the latter the part above the lowest pair of leaflets. When the petiole exceeds the first leaflet in length, the leaf is termed *petiolate*; when shorter than it but still evident, the leaf becomes *subsessile*; when the first leaflet arises contiguous to the stipules, the leaf becomes *sessile*. In North America the leaf-rachis of *Astragalus* is ordinarily flaccid and deciduous by weathering, less often weakly marcescent at base or throughout, only exceptionally becoming rigid or persisting through more than two winters. In three small and rare species, *A. Peckii, A. jejunus,* and *A. humillimus,* the petioles become stiffened and subspinescent but hardly vulnerant. There is no real approach in America to the spiny, tragacanthoid habit of growth so extensively developed in west and central Asia.

Inflorescence

The inflorescence of all *Astragali* is an axillary raceme, but this is greatly modified by variation in length of the peduncle, and in number, density, and orientation of the flowers, and it sometimes becomes technically spicate by reduction or suppression of the pedicels. The flowers may be arranged in long, loose, often more or less secund racemes, or aggregated into oblong or subcapitate heads, or disposed in loose clusters of falsely umbellate character. Those of the American species are subtended by a single bract similar in texture to the stipules. The bract is commonly pouched at base and embraces the pedicel to greater or less degree. The bud is always erect in vernation, but the flower rarely remains so. Usually through curvature of the pedicel or through oblique attachment of the calyx to an erect pedicel, the mature flower becomes variably spreading, declined, or deflexed. Most commonly the fruit follows the full-blown flower unchanged in attitude but sometimes, through alteration of the pedicel after fecundation of the ovary, it may assume a different posture. The ultimate state of the pedicel is described in greater detail in connection with fall and dehiscence of the fruit. The arrangement of the flowers and fruits plays a large role in determining the aspect of the whole plant.

Bracteoles

The bracteoles in *Astragalus* are appendages of debatable origin and significance, but very probably homologous with the stipules which they resemble in form. It happens repeatedly in *Astragalus* that stipules, bracts, and bracteoles vary together in vigor of development from plant to plant, as though their growth were determined by a common impulse. The bracteoles in American species are membranous or scarious, often minute, sometimes reduced to a filiform, hairlike structure hardly distinguishable from a genuine trichome; or they may be represented by minute callous areas at base of the calyx; often they are lacking. When present they are commonly attached at the point where calyx and pedicel join or just above it. More rarely they will be found at the edge of the calycine disc or on the pedicel just below the calyx. Bracteoles ordinarily occur in symmetrical pairs, but sometimes they are of unequal size, or irregularly inserted, or one is absent. They are consistently found in only a small proportion of our species and are consistently lacking in comparatively few. Most commonly bracteolate and ebracteolate individuals or populations occur in the same species. Bracteoles are of no systematic importance in North America.

Calyx

The calyx varies from shortly bell-shaped to cylindric, often a trifle compressed laterally, and consists of a tube cleft, as a rule obliquely, into five equal or con-

spicuously unequal teeth varying from shortly deltoid (broader than long) to subulate and from subulate to setaceous or rarely aristate. Often the ventral pair of teeth, separated by a wider sinus than the rest, are shorter than the lateral pair, but the dorsal one may be either longest or shortest of all. The tube, of thinner texture than the teeth, is described as *campanulate* when less than twice as long as its greatest diameter, as *cylindro-campanulate* when exactly twice as long, and as *cylindric* when longer. The proximal end is occupied by a more or less thickened, sometimes quite fleshy, bowl-shaped disc, often feebly nectariferous within and bearing the parts of the corolla around its inner edge. The disc is commonly set obliquely to the proper tube, and in some species is dilated behind the pedicel or even produced backward to form a gibbous sac. Note that measurements of the calyx-tube are taken from insertion of the pedicel to the lateral sinus between one lateral and one ventral calyx-tooth; it thus includes the calycine disc and ignores the often irregularly cut-back ventral sinus. In the remarkable *A. oocalycis* the whole calyx is inflated below the constricted mouth and encloses the small fruit, a character evolved independently in several Asiatic groups and in a few species of *Oxytropis*. As the pod matures, the calyx withers to a papery or membranous texture and is ruptured ventrally whenever too small to accommodate the expanding ovary. In a few *Sarcocarpi* and others not closely related the calyx-tube becomes scarious and fragile and is shed by circumscissile fissure about the disc's rim.

Corolla

The corolla of *Astragalus* is papilionaceous, composed of an adaxial *banner,* two free *wings,* and a *keel* opposed to the banner which consists of two petals cohering lightly by their exterior edges, all usually deciduous, rarely marcescent about the fruit. The banner is described as though composed of an oblanceolate to broadly cuneate claw bearing a blade of variable outline notched at apex or rarely entire. Claw and blade are usually well differentiated, but sometimes pass imperceptibly into one another. The blade is keeled dorsally, folded forward near the middle, and its margins then (nearly always) folded backward. Furthermore it is bent backward from the keel, its curvature, as viewed laterally, varying from about 10° to 120° or rarely 170° from the vertical. The curvature of the banner tends to increase as the blade shortens and the calyx becomes shallower, and often gives a characteristic aspect to the flower. The wings consist of a slender claw and a more or less dilated blade of variable outline provided at base, on the side facing the banner, with a reflexed auricle. Each blade is provided with a socket or pit situated a little above its junction with the claw, and this fits neatly over a corresponding nipple or low swelling which issues from the adjoining keel-petal. In many American *Astragali* the wings are asymmetrical, one of them, usually the left, being more strongly incurved than the other and bearing its blade loosely folded over the inner margins of the keel, whereas that of its opposite is twisted to stand at right angles to the keel-blade. In other species the wings are alike in curvature and their blades are loosely appressed or vertically opposed to the keel. The apex of the blades is often obliquely emarginate, more rarely cleft into two unequal teeth or lobes. The divisions of the keel, always mutually symmetrical, resemble the wings in form except that they have nearly always shorter blades and a smaller basal auricle. The asymmetrical blades, often characteristic of their species, are difficult to describe in words. The expression *half-obovate,* often repeated in these pages, implies a figure obtained by folding an obovate form along its axis of symmetry. The angle of the keel's curvature is measured from its departure from the vertical into the apex, understood as the point where the keel-blades become free from each other. The keel-tip varies from bluntly rounded to sharply deltoid or triangular, and is occa-

sionally drawn out into a shortly acuminate beak. When the exterior edge of the blade, at the expiration of its inward curve, again turns a little outward, the beak or keel-tip is called *porrect*. In all American *Astragali* the wings and keel are free above their origin at the margin of the disc, the claws never cohering (as so often in the Old World) with the staminal tube. In four of our species the petals (or some of them) are pubescent dorsally, in the vast majority glabrous. They are commonly graduated in length in the manner normal to the papilionaceous flower, the banner being longer than the wings, the wings in turn longer than the keel. Variations in this sequence are fairly frequent, however, and flowers with the banner conspicuously shortened, or the keel or wings greatly lengthened relative to the other petals, are often highly distinctive and characteristic of a species.

Color of the petals varies in America from almost pure white through shades of creamy or greenish-white to lemon-yellow, pale pink, lilac, reddish-lilac, brilliant magenta-purple, and in a few species crimson or scarlet. Often yellowish and purplish coloring conflict for dominance and the flowers become brownish or lurid in consequence. The petals may be concolorous, but when white or ochroleucous the keel-tip is often purple-spotted, and when mostly purple the wing-tips and fold of the banner are commonly pallid, the eye of the latter often penciled with reddish or purple veins. No *Astragalus* known to me has truly blue flowers, and none in America has flowers of a true bright yellow, such as are found in many members of the Old World sects. *Myobroma* or *Alopecias*; however, some ochroleucous flowers habitually turn yellow when dried. Purple flowers dry pinkish or brownish in most species, but in a few turn violet in the press, an effect attributed by Jones to relative acidity or alkalinity of the sap. The chemistry of the pigments in *Astragalus* has not been investigated.

Androecium

The stamens are diadelphous, the vexillary stamen standing free, while the rest are fused by their filaments into a sheath enfolding the ovary. Five filaments are ordinarily a trifle longer than the alternate five, so that the anthers stand in two ranks, one slightly above the other, and those of the upper set are ordinarily a trifle longer. The anthers, nearly round when small and varying with increasing length into oblong or linear, are composed of two parallel cells dehiscent lengthwise by means of slits. In most *Astragali* the anthers surround the style and ripen simultaneously with the stigma, thus ensuring self-fertilization of the flower. The pollen of *Astragalus* has not been studied systematically.

Gynoecium

The gynoecium consists of a linear or linear-ellipsoid, unilocular ovary seated on the more or less thickened base of the receptacular disc, which is often elevated into a squat cone or produced into a slender column or *gynophore,* and mistaken for a stipe. A genuine *stipe* is a linear, sterile basal portion of the ovary and is therefore continuous with the body of the pod, whereas a joint is always present between the gynophore and the pistil. The ovary is surmounted by an incurved, nearly always glabrous (in two North American annuals thinly puberulent) style capped by a minute stigma. The ovary encloses two to many campylotropous ovules borne in two or, when many and crowded, in four ranks on more or less elongate funicles. The number of ovules remains constant or nearly so within the species only when reduced to one or two pairs; variation in number increases proportionately with increase in average number.

Pod

No other genus of flowering plants exhibits greater variety in the form of the fruit which is, in its simplest but not necessarily its most primitive form, a more or

less asymmetric cylindric or ovoid-fusiform, single-chambered legume. The principal modifications which determine the form of the mature pod are size, outline, and curvature, degrees of compression from various directions, degrees of tumescence or inflation, all complicated by alteration in texture of the valves and very often by a more or less pronounced introversion of the endocarp as a recessive fold or double-walled septum arising from the dorsal suture and dividing the cavity partially or completely into two chambers. It would be impossible in a limited space to describe even in general terms the whole range of variation produced in the genus by counterplay of these variable factors which has given rise, especially in Asia, to some marvelously complex (as well as marvelously simplified) structures; I must confine myself here to the North American species. In our continent the *Astragalus* pod varies in length from 2 mm. to about 6 cm. in length; in outline, whether viewed dorsiventrally or laterally, it varies from narrowly linear to globose or even broader than long, and may be broadest at, below, or more rarely above the middle. Compression may be exerted from one, two, three, or exceptionally four directions simultaneously: when from one direction only it may proceed from either the dorsal or the ventral face; compression from two directions may be either dorsiventral or lateral. A pod compressed from three sides becomes triquetrous, the ventral suture nearly always determining one angle; in these cases the two lateral faces are symmetrical, whereas the dorsal one is often narrower and grooved lengthwise. The pod of *A. tetrapterus* becomes on ripening sharply tetragonal, with four longitudinal keels separated by four slightly concave faces of nearly equal width. A pod not truly compressed but at the same time inflated and grooved along both sutures assumes a didymous form. Independent of its mode of compression, the pod may be straight or curved, but some degree of curvature is so common as to be almost characteristic of the genus. Curvature, very variable in degree even within the species, is commonly directed inward, so that the ventral suture describes a more or less concave and the dorsal one an approximately parallel convex arc. The arc of curvature varies from scarcely perceptible to a full circle or rarely up to two and a half circles, when the pod becomes coiled in a helicoid spiral or equivalently distorted. Downward curvature, resulting in a convex ventral suture, is less common and only rarely pronounced. In a few species a gentle sigmoid curvature starts downward from the base and turns inward distally. Very commonly the pod is contracted above its base into a linear or sometimes stouter and clavate sterile segment, solid or nearly so, which is termed the *stipe* and serves to elevate the hollow fertile body, sometimes far beyond the calyx-mouth. It must be emphasized that stipe and body of the pod are one continuous structure developed directly from the ovary. In many species the pod is similarly elevated on a column or stalk of receptacular origin termed the *gynophore,* from which it disjoints on ripening; this is not part of the proper fruit. The body of the pod is contracted at varying distances below the apex into a nearly always differentiated and often prominent, laterally compressed (rarely conic or subulate), often acute or acuminate beak tipped by the persistent base of the style, this sometimes hardened into a rigid cusp.

The *sutures* of the *Astragalus* fruit represent the midrib and the fused margins of the carpellary leaf. The placentiferous suture is the adaxial one and is termed the *ventral,* that opposed to it being called the *dorsal.* The sutures vary from filiform to greatly thickened, prominent and cordlike; rarely they are immersed in the thickened tissue of the valves.

The *valves* of the pod, extremely variable in thickness and texture, are composed of three layers of tissue differentiated into an exterior, commonly thin exocarp, a similar or thinner endocarp, and an intervening mesocarp which largely determines the substance of the ripened fruit. The mesocarp of thin-walled pods is

reduced to a thin layer of small cells or becomes nearly obsolete, whereas the thick-walled and fleshy types of pod are composed very largely of mesocarpic tissue. The fully formed but still green fruit may be a transparent envelope which will alter little as it dries, but it is more often fleshy to some degree and only assumes its characteristic texture after the sap evaporates or is gradually withdrawn. Differing textures of the ripe fruit offer valuable diagnostic characters in the genus, but no exact objective vocabulary has been evolved to describe them, for texture depends not on thickness of the valves alone, but also on the nature of their cellular structure and to some degree on their tensile strength. Pods are described as: *membranous,* when very thin and more or less diaphanous, the ripe seeds within being visible without transmitted light; *papery,* when thin and flexible but opaque, varying in thickness from that of ordinary notepaper to that of heavy wrapping paper; *leathery,* when thicker than paper but still malleable to the fingers; and *woody,* when rigid to the touch. Composite terms such as *papery-membranous* are ambiguous but self-explanatory. In a few species the pod is of extremely thick texture and when first formed succulent like a green plum or cherry. The large cells of the mesocarp, at first charged with a watery juice, retain their alveolate architecture as the sap is lost, and form a deep layer of extremely light and fragile pith contained within the firmer shells of the exocarp and endocarp. The term *alveolate-spongy* has been used to describe this type of pod. Commonly the pod's valves closely invest the ovules and seeds, and often the inner wall of the endocarp gives rise to filaments, at first juicy but becoming dry and cobwebby in age, which are sometimes so long and closely set as to fill the cavity with pith. Very often the pod is tumescent and is said to be *inflated* whenever the cavity is substantially greater than required to accommodate the seeds. Whenever greatly swollen and at the same time of papery or membranous texture, the pod is termed *bladdery* or ventricose.

The exocarp of the *Astragalus* pod is traversed at right angles to the sutures by parallel but more or less intricately anastomosing nerves which vary in number between but only to a small extent within the species. These nerves usually become prominent only as the pod ripens and the valves shrink in drying; they may form a conspicuously elevated network or, especially in some thick-walled fruits, remain immersed in the exocarpic tissue. The surface of the valves often becomes rugulose, pitted, or wrinkled in ripening, or may remain perfectly smooth and lustrous into maturity. The superficial cell-layer, especially of surfaces turned toward the sun, is often stained with anthocyanin. The pigment may be diffused continuously through the cells, but it tends to become concentrated in definite patches very variable in extent. The pod thus may appear freckled all over with minute red or purple dots or with slightly larger and confluent blotches. Very frequently the dots and blotches run together to form indefinite but nearly equidistant hieroglyphic or zebra patterns. Some mottled pods, especially when highly colored, are of striking beauty.

An important feature of the *Astragalus* pod is the *septum* or longitudinal wall produced across the cavity from the dorsal suture. It consists of a recessive fold of the endocarp, neither exocarp nor mesocarp playing any role in its origin. It follows that the dorsal suture of the pod is always superficial and never folded inward. A septum is called complete when it extends across the cavity at some point to reach or even fuse with the interior edge of the ventral suture, and pods so endowed are termed *bilocular,* a term which should replace the "two-celled" common in the literature of the genus. A septum extending halfway across the cavity or one reduced to a narrow ridge or stall renders the pod *semibilocular* or *subunilocular,* as the case may be, and a pod lacking septum altogether is termed *unilocular* (or "one-celled"). Often the septum, even though complete at the middle of the pod, runs out at the base of the beak, providing egress to the seeds of apically dehiscent fruits; but

almost as frequently it is produced into the beak's apex, dividing the pod into two perfectly closed chambers. At dehiscence the dorsal suture of the pod often splits lengthwise, and the walls of the septum, which cohere only lightly, separate readily, their inner walls becoming exterior to the dehiscent fruit.

Whether a genuine septum is present or not, the cavity of the pod is sometimes partly divided into two chambers by an outgrowth from the ventral suture. It appears as a narrow wing or flange connecting the stalks of each rank of ovules and thus resembles, on a small scale, the web between a duck's toes. The two halves of the flange separate readily in age and can be seen most easily in a pod split lengthwise. For convenience of reference this outgrowth is termed the *funicular flange.* In some fully bilocular pods the flange embraces and partly coalesces with the inner edge of the septum proper. The flange is highly developed in some *Inflati* and *Diphysi* and occurs in the pod of many *Oxytropis,* where it has been described as a ventral septum.

Fall and Dehiscence of the Pod

The ultimate history of the successfully ripened pod, which involves its separation from the parent plant and the discharge of the seeds, is varied and of great theoretical interest. In some species, or in whole groups of species, the pod remains permanently attached to the receptacle, and the thickened pedicel supporting it remains as firmly attached to the raceme-axis; the whole fruit may persist over the winter on the withered stems, only to disintegrate by gradual weathering. Pods of this nature dehisce distally and shed their seeds through the gaping beak, which splits downward through both sutures to a depth variable with the species, but often further ventrally than dorsally. Separation of the pod from its raceme occurs by fracture at one or another of two joints, one at the junction of the pedicel and the main axis, one at the junction of the receptacle (including the gynophore if present) and the pod. In many species, among them all those with pods at once pendulous and stipitate, the fracture occurs at base of the pedicel, and this falls together as a unit with the marcescent calyx and the fruit. In such cases dehiscence may be apical, basal, or through the length of both sutures, and may either precede or follow separation from the raceme. Rather more often the pedicel persists on the raceme together with remains of the calyx, and the body of the fruit falls alone, either directly from the flat or conic receptacle or from the stipelike gynophore. Here dehiscence takes place naturally on the ground and may be primarily apical, or both apical and basal, or long delayed and dependent on weathering, or possibly in a few cases on animal intervention. There are a few instances where the pod splits in half as it is discharged, falling, when bilocular, in the form of two follicles, each closed by its half of the septum. A third method of falling entails fracture at both points mentioned and a more or less simultaneous separation of pedicel from raceme and receptacle from pod; dehiscence then occurs on the ground after falling.

The method of the pod's discharge provides important clues to the phylogeny and interrelationships of the North American *Astragali* and is mentioned repeatedly in discussions of affinity. For ease of reference the species with pods persistent on the raceme (or the pods themselves) are termed *emmenoloboid,* those with pods deciduous from the receptacle (or gynophore) as *piptoloboid,* words derived from Greek verbs meaning to remain and to fall combined with the old root *lobos* or legume.

As the walls of the pod dry out and shrink in ripening, some degree of tension is ordinarily set up in the contracted tissue of the valves and the bowed sutures, and dehiscence occurs from a sudden split through some part of the sutures, resulting in release of tension. In *Astragalus* the release is seldom so rapid or violent as to

eject the seeds forcibly to any great distance. In some species the valves of a laterally compressed, two-sided, unilocular (or so-called *homaloboid*) pod separate rapidly along their whole length from tip to base and immediately coil lengthwise in the manner of *Vicia* or *Lotus*; but in most *Astragali* dehiscence is a gentle and prolonged process. The contention of Ginsbourg (1908) that dehiscence in *Astragalus* is determined by the vascular structure of the septum was based on superficial observation of too few species.

Seeds

The *Astragalus* seed is estrophiolate and varies from almost round to oblong in outline. It is laterally compressed and more or less deeply notched at the hilum, becoming when deeply emarginate obliquely reniform or mitten-shaped. Seeds crowded into a narrow pod often become more or less prismatic or quadrangular from mutual pressure during the growing period. The seed coat may be smooth and lustrous, smooth but dull (when microscopically roughened in reality), or variously wrinkled, pitted, or punctate. The testa varies in color from ochraceous through shades of brown to ebony-black and is often suffused with tones of green, indigo, or purple. Seeds which ripen in the pod after pressing may remain viable but fail to color up as do those ripening undisturbed on the plant. As happens in the mottled epidermis of the pod, anthocyanin in the seed-coat often runs together to form red or purple dots and blotches. Seeds of some desert *Astragali* retain their vitality for thirty or forty years, perhaps longer, germinating readily if thoroughly soaked.

Chromosomes

The cytogenetics of *Astragalus* is still in an early exploratory stage and is hampered by the number of species involved and the remoteness and rarity of so many. A fair number of isolated chromosome counts are on record, but the North American seleniferous species and Rydberg's genus *Hesperastragalus* are the only groups that have been investigated systematically in connection with a taxonomic study. Knowledge of chromosome number in *Astragalus* has been greatly extended of late by Ledingham, whose summary paper (1960) reviews the subject as known to date. The majority of Old World *Astragali* have a basic $n = 8$, and this same number is found in all *Oxytropis* examined, and in all North American *Astragali* which have close relatives in eastern Asia. The sections of *Astragalus* endemic to the New World present with few exceptions an aneuploid series of $n = 11$, 12, and 13. From this evidence Ledingham infers that Eurasian *Astragalus* together with *Oxytropis* and the so-called *Astragali* of the New World represent phyla which have enjoyed a period of mutual isolation dating back to the remote origins of both; and it would follow that their development has been independent, even if parallel, and that the two groups deserve recognition at the generic level. Unfortunately no external morphological character is known to go hand in hand with chromosome number.

Chromosome number of itself promises no open sesame to the systematics of the genus, although a more refined study of chromosome structure and behavior may throw light on its phylogeny and internal architecture. A common number has confirmed the naturalness of some small groups, which had been recognized as such by means of more easily observed properties; but since the same number occurs in pairs or groups of species extraordinarily dissimilar in other ways, it is often a negative character in the assessment of affinity. The utility of the cytogenetic data that we now possess is diminished by its incompleteness. Counts for eighty-odd North American species have been published, but this number is less than one-fourth of the total recognized in these pages. The percentage of Old World species

examined cytologically is considerably smaller, while the percentages in South American *Astragalus* and in *Oxytropis* are in the neighborhood of 10–12%. The counts which we do have are concentrated into a comparatively small number of species-groups, leaving some of our largest sections (e. g., *Strigulosi*) and many of our peculiar monotypes untouched. The 82 North American species of which we have recorded chromosome numbers are dispersed through 50 of the 93 sections. Moreover we are wholly ignorant about numerous, possibly primitive types endemic to the mountains of central Asia and southern China, as also about the majority of the highly modified species-groups native to the Andean plateau.

The chromosome numbers of our American species are given in the Synopsis (pp. 37–53).

Phylogeny

No attempt at a comprehensive phylogenetic system for the world's *Astragali* has ever been attempted, at least since the quite formal catalogs of Pallas and De-Candolle (1800–1802), and none is yet in sight. Intimate knowledge of the entire genus at the level of species is a prerequisite, and in an age of political dissension in the northern hemisphere this is perhaps out of reach of any one man. An approach to a system by way of the literature is handicapped by the fact that different sets of morphological characters have been found useful for taxonomic purposes in different geographic areas, and it is these characters that have been emphasized in descriptions and keys. It has been common practice in Asia to describe *Astragalus* species from flowering specimens; in America the historic emphasis, at least for the last hundred years, has been on the pod. Ovule-number, considered important in Asia, has only now been investigated systematically in our species. The *Astragalus* flower has seldom been considered worth describing in any really fine detail in America, and the pod's fall and dehiscence have been almost completely ignored in the Old World. Groups of *Astragalus* species adapted and often confined to soils from which selenium can be extracted are known to exist in South America and are indicated in Asia, but I have no knowledge as to their extent or of possible affinity to the seleniferous sections in our territory. In brief, comparable data for several important branches of the phylogenetic tree are still lacking, and significant or fruitful comparisons are not possible.

As shown in the foregoing historical sketch, the growth in North America of a taxonomic structure on the basis of fruiting characters had its source in a pre-Linnaean concept of a bilocular *Astragalus* contrasted with an unilocular *Phaca*. Early in the preparation of this Atlas it was realized that the system established on these foundations by Gray, subsequently refined by Jones, and carried out by Rydberg to an extreme elaboration, is an artificial one. If the system were natural, it would surely have accommodated without serious strain or dislocation at least the majority of modern discoveries, but in this respect it has repeatedly been found inadequate. Perhaps the most remarkable single characteristic of the genus *Astragalus* as a whole, and it is especially marked in North America, is that there are hardly two species, even very closely related, which do not differ one from another in form or structure of the fruit. This thought can be expressed in another way: the evolution of the species in *Astragalus* has nearly always involved some alteration of the gynoecium. The so-called natural system of plant classification is based largely on the assumption, no doubt true in a broad sense, that the reproductive organs of a plant are the least subject, or the least sensitive to evolutionary pressures, and therefore provide the best clues to affinity and origin. In *Astragalus* the pod is clearly sensitive and subject to just these pressures, and it is precisely the diversity in its external form, texture, and inward structure that devaluates the pod as a

sound basis for a taxonomic system, even though it had made such a system possible in the first place.

While it is easy to ridicule or condemn the misconceptions or the excesses of one's predecessors, it is another matter entirely to modify the old system or construct a new one which will harmonize with what is already known and yet provide a framework for the unforeseeable. The so-called phylogenies, which current botanical fashion seems to require of the taxonomic worker, are for the most part flimsy structures, compounded of nine parts speculation to one of observed fact; many of them collapse under logical scrutiny and serve no useful purpose. Nevertheless the post-Darwinian taxonomist who ponders his subject with an affectionate intensity which it deserves is bound to evolve in his own mind some hypothesis or set of principles upon which to build an orderly arrangement of the organisms under study. Indeed, order comprehensible to the human mind is the goal of taxonomy. The professed aim of the taxonomist is often called a "natural" system, but the system can never be more than a formal reflection of the truth, standing in much the same relation to truth as a two-dimensional picture stands to the phenomena of a three- or four-dimensional reality. It is obvious that a linear sequence cannot do justice to an evolutionary tree which by definition exists and has existed in the past, a tree from which whole branches may have perished without a trace, a tree of which the spread and trunk can only be deduced from a superficial acquaintance with a handful (in *Astragalus* an admittedly overflowing handful) of terminal twigs and branchlets, a tree which may have no truly arboreal pattern of ramification but may have become, through anastomosis of the branches, a more or less elaborate network of hereditary lines.

Phylogenetic speculation rests largely on an assumption that evolution and specialization have gone hand in hand. It is important to remember that these processes may not (obviously do not) proceed at the same pace while specialization may involve apparent simplification as well as apparent elaboration of a given organ and may itself be subject to reversal as well as progress. In spite of the difficulties of interpretation, relatively primitive and advanced stages of development have been very plausibly demonstrated in some genera (e. g., *Crepis*). In *Astragalus*, however, which, like most genera of largely herbaceous and largely xerophytic nature, has left no fossil signpost marking the path backward into prehistory, the clues to what are primitive and what are advanced characters are contradictory or at best controversial. No sooner is a given morphological feature picked out as ostensibly primitive than a particular instance can be adduced where the character is almost as certainly recently acquired. We can speak of primitive *Astragali* only in broad, general, and always tentative terms, and must forego any attempt to assign a set value to any one character or its absence. Nevertheless in my attempt to arrange the North American species into what appears a more natural sequence than has been achieved hitherto, I have come to envisage a few features as more often than not representing a genuinely primitive evolutionary stage, and these deserve a word of comment. I propose therefore to take up the organs already described in the section dealing with "Morphology and Descriptive Terms" and reexamine them in the light of evolutionary theory. No discussion of the phylogeny of *Astragalus* would be complete which did not consider *Oxytropis* DC. as organically (even though not nomenclaturally) part of the genus, and I shall therefore apply the same criteria to this genus as I proceed.

1. *Habit of Growth and Duration.*—It is reasonable to suppose that the prototypes of *Astragalus* and *Oxytropis* were caulescent perennials, with a taproot and superficial root-crown. The taproot is universal, found in all groups of species in both genera. An herbaceous habit has persisted in all the major subdivisions (subgenera

of the Old World; phalanxes of the New) of *Astragalus* except *Tragacantha,* which must have become shrubby or at least suffruticose before fragmenting into sections and species. The evolution of rhizomes from subterranean caudices is correlated with adaptation of the organism to two quite different types of habitat, tundra in the case of *A. alpinus* (cf. also the subtropical alpine *Strigulosi*) and dune in the case of *A. ceramicus.* It is an obvious specialization which has occurred independently at several levels of evolution in *Astragalus* but never in *Oxytropis.* Development of stems persistent as an aerial caudex and also the telescoping of the stem-axis into an acaulescent tuft have occurred independently in different lines of heredity in Old World and New World *Astragalus* and independently in *Oxytropis.* Several perennial lines have given rise independently to annual forms. The subgen. *Trimeniaeus* Bge. appears polyphyletic; certainly our annual *Inflati, Micranthi,* and *Microlobium* do not form a natural unit but have closer kindred among sympatric perennials. In general, similarity of growth-form or duration may afford a clue to kinship between species, but is often of no significance at a higher level.

2. *Vesture.*—The dolabriform hair is obviously derived from the basifixed one. In Asia the dolabriform type seems to have appeared before recent differentiation of species, and as a result the presence of two-armed hairs can be used successfully to delimit natural groups. In North America (disregarding sects. *Uliginosi* and *Onobrychoidei* of gerontogean origin) this is not so. Here the dolabriform hair must have developed more recently; it is sometimes common to members of a section but more often scarcely more than a good specific character. In two of our multiracial species *(A. Kentrophyta, A. miser),* which seem to be in a stage of active contemporary evolution, the vesture is also in process of differentiation, in some races largely dolabriform, in others largely or wholly basifixed. In *Oxytropis* dolabriform vesture has developed only in one marginal species, the North American *O. Lambertii,* which is clearly derived from an Asiatic group. The type of vesture thus must have become stabilized at several evolutionary levels independently. The presence of the relatively primitive basifixed hair is by no means a symptom of age or primitiveness of the species.

3. *Stipules.*—The stipules of *Leguminosae* must have been primitively free one from the other and from the base of the leaf-stalk (issuing generally from the leaf-pulvinus), but it is far from certain that this was so in the prototypes of *Astragalus* and *Oxytropis.* Wherever connate stipules appear in either of these genera, they are most strongly united low on the stems or branches, and often it is only the first 1–3 pairs in the ontogenetic sequence (starting with the first leaf after the cotyledons, or the first leaf of the year's annual growth) that are connate. A reversed sequence is unknown. If the history of the ancestral development is reenacted in the individual ontogeny, it would seem that in the present context united stipules are primitive to free ones. Almost throughout the genus apparently natural groups are characterized by connate (or in subgen. *Caprinus* by adnate) stipules, but the connate groups are as dissimilar as possible in other respects. Connate stipules may be linked with combinations of highly specialized characters (sects. *Orophaca, Drabellae,* subsect. *Monospermi;* the pulvinate Andean spp.; the Old World annual sect. *Edodimus* Bge.; the Chilean annual *A. triflorus* (DC.) Gray), but are equally frequent or more so in such ostensibly primitive groups as sect. *Oroboidei* and some of the mesophytic caulescent *Oxytropis* of Asia. The appearance of connate stipules in one of a pair of kindred species and free stipules in the other (our *A. caricinus* and *A. Lyalli; A. Nuttallii* and *A. pomonensis*) demonstrates, nevertheless, that union of stipules may be either lost or acquired at a high level of specific differentiation, and there is every reason to suppose that both loss and gain have occurred. For this reason a phylogeny based on stipular characters could have no reality.

4. *Leaf.*—It is a reasonable hypothesis that the primitive *Astragalus* leaf is that of other galegoid *Fabaceae,* imparipinnate with perhaps 5–8 pairs of petiolulate leaflets. Parallel modifications of the foliage occur in many galegoid and hedysaroid genera, in *Oxytropis,* and in several obviously unrelated groups within *Astragalus;* these involve multiplication or loss of leaflets, loss of the petiolule, alteration in texture of the blades, development of a spinous leaf-stalk and rachis, or of a spinulose midrib to the leaflets, but none throw any light on the phylogeny of the genus except within closely knit groups of related species. Modification of foliage to match the environment is characteristic of the family.

5. *Inflorescence.*—The pedunculate raceme of fairly numerous (perhaps 10–20) nodding flowers similar to that of *Galega* seems to be the least specialized form of inflorescence, and it occurs in most of the larger groups of *Astragalus* as well as in the presumably primitive caulescent *Oxytropis.* Loss of the common peduncle, loss of the individual pedicels, an erect orientation of the flower at anthesis, reduction or contraction of the raceme into a few-flowered false umbel, a radical cluster, or a dense spike, these are surely all derived characteristics and all can be illustrated by individual species of *Oxytropis* as well as *Astragalus.* From the phylogenetic viewpoint little can be learned from the type of inflorescence, even if the general trend of evolution is abundantly clear. An abrupt and presumably recent alteration in type of inflorescence is illustrated by two *Chaetodontes,* the racemose *A. Lyalli* and spicate *A. Spaldingii,* and by our two *Megacarpi, A. oophorus* with racemes of many nodding flowers and *A. megacarpus* with subradical, very short racemes of ascending flowers. Nevertheless the racemose type of inflorescence must have been extremely durable, having persisted into many of the most highly modified annual groups. By contrast the inflorescence of subgen. *Caprinus* and *Tragacantha* must have been modified even before the differentiation of sectional groups.

6. *Flower.*—In North American *Astragalus,* as also in *Oxytropis* sens. lat., there are two common types of flower, ordinarily distinguished with ease despite the existence of a continuous series of intermediate stages. In one the calyx is shallowly campanulate, the banner is obovate and recurved through 45° or more, and the wing- and keel-claws are only one-fourth as long as the blades. In the other the calyx is deeply campanulate to cylindric, the banner is oblanceolate and recurved through less than 45°, and the claws of the inner petals are proportionately longer. The two types are illustrated by *A. vexilliflexus* and *A. Purshii,* and by the Asiatic *Oxytropis floribunda* (Pall.) DC. and *O. chionobia* Bge. There are clear correlations in *Oxytropis* between the shorter type of flower and the less specialized, caulescent, and often mesophytic sections of the genus on the one hand and between the longer, narrower flower and the cespitose and xerophytic groups on the other. In both genera the short flower is more often nodding, the long flower more often erect. It seems reasonable to suppose that the longer, narrower flower is the derived type. It may be safely assumed that the graduation of the petals prevalent in *Fabaceae* (banner longest, keel shortest) is primitive in *Astragalus,* especially since the comparatively rare irregularities (keel, wings, or rarely both, enlarged in relation to the banner) affect only solitary species or small groups of closely related ones. A calyx inflated after anthesis is past and in fruit enclosing (and falling with) a small, few-ovulate pod is the distinguishing character of two large subgenera of Old World *Astragali,* but this calyx occurs in America only in two widely disparate groups (sects. *Oocalyces* and *Chaetodontes*) which can have no direct connection either with one another or with their Asiatic counterparts. In *Oxytropis* the same type of calyx has made independent appearances both in North America (*O. multiceps* Nutt., *O. Lagopus* Nutt. vars.) and in central Asia (*O. includens* N. Basil.). The obviously specialized phenomenon of the inner petals becoming

attached by their claws to the staminal tube, common in Asia, has not occurred in America. In general, the probable course of evolution of the astragaline flower can be postulated, but as the same types of specialization have made several, mutually independent appearances in mutually remote lines of descent, the flower by itself offers no firm phylogenetic evidence.

7. *Androecium.*—The androecium of *Astragalus* and *Oxytropis* is monotonously uniform (disregarding one exceptional monadelphous species in Asia). With increased size of the flower the anthers become longer but not significantly wider, thus tending to assume an oblong rather than plumply oval or round dorsiventral profile. Also increase in size enhances the dissimilarity between the anthers of the five longer and five shorter stamens.

8. *Pod.*—The protean nature of the *Astragalus* pod has attracted comment from early times, and it is only natural to speculate about the course or courses which have been followed in the evolution of its primitive state into the highly modified and diverse structures of contemporary species. In North America interest has centered on the development of the septum, the feature of the pod which, even though not present in all *Astragali,* and absent from the majority of *Oxytropis,* has alone served to distinguish the poorly characterized tribe *Astragalanae* from *Galegeae* sens. lat. In fact, the septum has at least since 1864 determined the form taken by all systems of classification proposed for our species. Gray (1864) was the first to arrange the North American *Astragali* in a sequence, starting with a pod fully and broadly bilocular and passing by way of the semibilocular into a strictly unilocular state. Rydberg (1929) reversed the order of precedence, starting with a pod at once laterally compressed and unilocular and proceeding through the unilocular obcompressed, the unilocular terete, the semibilocular thin-textured, and the semibilocular coriaceous into a variety of fully bilocular types. It is improbable, however, that either Gray or Rydberg would have drawn phylogenetic inferences from these sequences. Gray's order of presentation was devised to illustrate the insensible transitional steps by means of which the classical *Phaca* passed into *Astragalus* as conceived up to that time. So far as I can learn, Rydberg's thought was scarcely touched by evolutionary theory, and his scheme of arrangement is more than anything an exercise in formal logic which makes no pretense to phylogenetic method. On the other hand, Jones (1923, introduction, passim, but especially p. 18) claimed that his Revision rested on intuition of what he called "genetic relationships," that is, similarities between species and between groups of species not in the pod alone but also in growth-habit, floral morphology, ecology, floristic relationships, and type of dispersal. Jones was much more successful than either Gray or Rydberg in recognizing natural affinities, and even if some of his sections were so large and heterogeneous as to lose practical utility, all (with a few minor adjustments) still carry conviction. Nevertheless the pod's form continued to dominate the systematic pattern. Jones considered his *A. campestris (A. miser)* to be the most primitive American *Astragalus* for no other reason than that its flattened, elastically dehiscent, unilocular pod somewhat resembles that of *Hosackia* (i.e., *Lotus* L., p.p.) and *Lathyrus.* The unspoken thought behind such a statement is that the pod of *A. miser* has come down virtually unchanged since the distant period when the *Loteae, Vicieae,* and *Galegeae* had their inception. But this is almost certainly untrue. It so happens that *A. miser* is one of the most critically variable of modern *Astragali,* a species exceptionally rich in biotypes and showing many signs of an active evolutionary stage. It is not impossible that the pod is primitive; it is more likely that its simplicity of structure is due to suppression of the septum. It is easy, but not always correct, to equate primitiveness with simplicity, and Jones fell into this trap. In devising a system for the North American species, Jones took

the unilocular (but otherwise heterogeneous) *Homalobi* as a point of departure and thence (1923, p. 27) drew up a palmately forking, phylogenetic tree of five main branches, four of them composed at base of unilocular types, but three of these going out distally into a variety of bilocular forms. The important innovation of this scheme of so-called genetic relationships, whatever one may think of it in detail, lies in the recognition that a bilocular pod cannot have been developed in a straight evolutionary line or by a single, orderly process of differentiation (as suggested but not specifically claimed by Gray and Rydberg), but must have arisen independently several times. No one, I think, is likely to challenge this view, except to qualify it as an oversimplification of a yet more elaborate reality. The fact that a septum, at best poorly developed, is known only in some few acaulescent, xerophytic *Oxytropis* with erect flowers and in none of the caulescent, mesophytic species with pendulous flowers, which make up the ostensibly primitive subgen. *Phacoxytropis* Bge., suggests that at least in this particular line of inheritance the septum is an acquired character. However in Old World *Astragali* the situation is different. Among them are relatively few unilocular types, but of very diverse character: isolated monotypes such as *A. lusitanicus* Lamk., in which the immense leathery bladders of the fruit dehisce elastically as in some American *Homalobi,* or the peculiar annual *A. mirus* Širj. & Rech. f., with a tiny, laterally flattened, disclike, one-seeded fruit concealed within the calyx; well-integrated and relatively isolated sections such as *Cenantrum* (Koch) Bge. (=sect. *Phaca*), with stipitate, membranous, apically dehiscent bladders elevated on a threadlike stipe, and the well-integrated group of sections characterized by a shrubby spinose growth-habit, highly modified flower, and monospermous fruits which form the numerically important subgen. *Tragacantha* Bge.; and a sprinkling of unilocular forms scattered through otherwise bilocular sections (cf. *Myobroma* Bge.). Surely all of these cannot represent primitive survivals of an originally simple, *Lotus*-like fruit, though it is far from impossible that some of them do. North America is much richer in unilocular forms than either the Old World or South America, and here the clues to what is primitive in the *Astragalus* fruit are as contradictory as they are numerous. We need only adduce the instances of our *A. Nuttallianus* var. *imperfectus,* an indisputable example of loss of septum in one geographic race of a bilocular species, and of *A. leucolobus* with the closely related *A. Purshii* var. *tinctus,* where a septum must be a recent acquisition in the context of the largely unilocular sect. *Argophylli,* to show that mutations involving the septum can proceed in either direction. There is no reason to suppose that similar modifications could not or have not occurred in the long period during which the prototypes of *Astragalus* in the New and Old Worlds have differentiated into the sections and subgenera that we know today. It is safe to assume that a relatively primitive stage in the pod can be recognized in the context of some small, obviously interrelated groups of species, but that there is no objective criterion by which the primitive can be identified in the genus as a whole. It follows that a phylogeny resting on a single pod-sequence is an entirely arbitrary and artificial concept.

Other features of the pod which have attracted less notice but seem to have some limited value as clues to a natural classification, are its mode of compression, the texture of its valves, its orientation at maturity and its discharge (if any) from the raceme, its dehiscence, and finally the number of ovules or seeds. It seems likely, although no proof is possible, that a more or less trigonous mode of compression became established early in the differentiation of *Astragalus,* for this type has persisted in all the major divisions of the genus other than *Tragacantha* and in all three major areas of dispersal. A trigonous compression easily gives rise to a recessive dorsal suture which in turn paves the way for the inflexion of the endocarp in the

form of a septum. The three-sided pod modified by inflation of the valves or by a decided compression from both sides becomes altered when unilocular into the so-called phacoid and homaloboid types of fruit. A secondary inflation subsequent to development of a septum would produce the didymous fruits of sect. *Diphysi* and *Diphaci* in North America and Bunge's sect. *Cystium* in Asia; a secondary lateral compression culminates in the externally homaloboid but fully bilocular pod found in some species of sect. *Diplotheca* Bge. and our *A. Jaegerianus,* not to mention the South American species with turgid fruits which are nevertheless strongly carinate by both sutures. A strong dorsiventral compression of the unilocular pod has occurred only rarely in *Astragalus,* and apparently only in America (sect. *Lonchocarpi*; *A. pterocarpus*), but a secondary dorsiventral compression subsequent to the development of a septum has produced some of the most highly evolved types, especially among annual groups in North America and Eurasia: *A. scutaneus*; the central Asiatic *A. Schmalhausenii* Bge.; or *A. Pelecinus* (L.) Barneby[1] of the Mediterranean Basin. Compression from the ventral face of an unilocular pod seems to have become stabilized in *Oxytropis* at a very early period, perhaps at the time its prototype began to diverge from some primitive astragaline stem. It is found in all sections of the contemporary genus, only sometimes masked by a bladdery inflation which must have developed independently in Asia (*O. rhynchophysa* Schrenk) and America (*O. podocarpa* Gray, *O. Jonesii* Barneby). While the type of compression has often remained stable during the differentiation of one line of inheritance into a group of species which remain alike in this respect, there are examples of an abrupt change from a three-sided to a two-sided pod (or vice versa) in such pairs of species as *A. spatulatus* and *A. drabelliformis,* or *A. proximus* and *A. wingatanus.* Modifications of the same type may have taken place at any period in the past.

It is reasonable to consider as primitive, or at least unspecialized, the texture of the pod-walls called papery in these pages, that is neither greatly thickened nor membranous and transparent. It is the texture found in most *Phacoxytropis.* Thickening of the valves into increasingly tough, juicy, or ultimately pithy textures usually coincide with adaptation of the plant itself to arid conditions; but it is interesting that a membranous pod has developed independently in mesophytic *(Hemiphragmium)* and xerophytic *(Inflati)* sections. Relatively thin- and thick-textured fruits are characteristic of some large, closely coherent divisions of the genus, but evidence of recent and abrupt change in thickness of the valves offered by such pairs of twins as *A. cimae* vars. *cimae* and *sufflatus, A. lentiginosus* vars. *salinus* and *platyphyllidius,* or *A. Beckwithii* and *A. oophorus* var. *caulescens,* devaluates the character as a reliable clue to evolutionary progress.

It seems a likely hypothesis that in *Astragalus* a pod continuous with the receptacle and probably also pendulous is primitive. Fruits of this type seem to be the least specialized to survive in the genus today. Moreover they are typical of *Phacoxytropis* and are very frequently associated in *Astragalus* with other ostensibly primitive or non-specialized traits. A pendulous, emmenoloboid pod seems originally to have fallen with the disjointing pedicel; at anthesis this joint is present in all *Astragali* known to me and allows the unfertilized flowers to drop off as they fade. Thickening of the pedicel and permanent consolidation of the joint at its base

---

[1] *Astragalus Pelecinus* (L.) Barneby, comb. nov. *Biserrula Pelecinus* L., Sp. Pl. 762. 1753.—The crenate margin of the lateral wings is no more remarkable than the spinose margins in *Severzovia* Regel & Schmalh., now unanimously accepted as a highly modified *Astragalus.* Up to and including the flower, *A. Pelecinus* is a perfectly unexceptional *Astragalus,* but its modified pod entitles it to a monotypic sect. *Biserrula* Barneby, stat. nov. (*Biserrula* L., pro gen., l. c.), related to sect. *Oxyglottis* Bge. (sect. *Sesamoidei*).

may legitimately be considered as an evolutionary step forward. As a result the permanently marcescent pod sheds its seeds from the raceme. The thickened, persistent pedicel often becomes straight in age, whether it proceeds either from an erect or a pendulous flower, and this brings the ripening pod into an erect attitude. It is at this point that a second joint seems to have developed between the receptacle and the ripening gynoecium. A pod which falls away when ready to dehisce is blown hither and thither by the wind, scattering the seeds as it goes, and provides a much more efficient mechanism for dispersal than the emmenoloboid fruit. Part of this evolutionary sequence is neatly illustrated by sect. *Ervoidei,* where the pendulous stipitate fruit of *A. tenellus* passes by way of the sessile but still persistent one of *A. vexilliflexus* into the sessile, deciduous one of *A. Kentrophyta,* the change in the fruit being accompanied by increasing specialization in growth-habit, foliage, and habitat. No doubt the same or closely similar trains of events have occurred in several lines of inheritance. In subgen. *Tragacantha* the pedicel must have been lost and the piptoloboid fruit stabilized before the evolution of the component sections and species. In *Oxytropis* the process has been carried out only so far as thickening of the erect pedicel; in this genus (so far as known to me) the pod falls, if at all, accompanied only by the pedicel and marcescent calyx. In *Astragalus* we find parallel modifications of the pod's discharge both in the 8-chromosome Eurasian groups (e.g., sect. *Hemiphaca,* represented in America by *A. Williamsii*) and in the aneuploid American series. A reversed sequence seems to occur only rarely. A few *Inflati* (e.g., *A. gruinus; A. piscinus*) seem to have lost the joint between the pod and the receptacle and reverted to a discharge effected by a disjointing pedicel. In sect. *Micranthi* we have the unique example of an erect, sessile, piptoloboid pod becoming at first sessile and persistent (*A. coahuilae; A. Nuttallianus* pro max. parte) and this leading on, through forms of *A. Nuttallianus* var. *macilentus,* to the highly modified *A. Lindheimeri,* in which an erect, stipitate, persistent pod has regained the relatively primitive character of some of our bilocular, homaloboid types. The development of a stipe is associated always (but see the peculiar annual *A. Clarianus*) with a persistent fruit and seems to be a very easily lost and easily acquired feature, as shown by the number of twin species, or even forms of the same species, which differ one from the other (cf. *A. tenellus; A. praelongus* var. *praelongus* and var. *lonchopus; A. eucosmus* and *A. Robbinsii; Oxytropis nigrescens* (Pall.) DC., sens. lat.) in this character. The presence or absence of a stipe seldom throws light on affinities or origins.

It may be assumed that a complement of perhaps 6–10 pairs of ovules and seeds disposed in two ranks is the least specialized and very likely the primitive number and arrangement, both in *Astragalus* and *Oxytropis*. This moderate number is found in the majority of the ostensibly primitive types of pod, and is often associated with other non-specialized features; but in *Astragalus* it has persisted into all levels of differentiation. Reduction of the ovules to one or two pairs, and of the seeds to one, two, or four, is an obvious specialization which has occurred independently several times (cf. subgen. *Tragacantha*; our sect. *Microlobium*; *A. Kentrophyta* (in part). Similarly the multiplication of ovules, which tend to fall into four parallel ranks when numerous and crowded, is an advanced character. A high ovule number is ordinarily associated with a thick-walled, and in America also deciduous pod, but among North American species there are some pluriovulate, deciduous bladders (e.g., *A. Douglasii*) and some pluriovulate, persistent woody pods (e.g., *A. praelongus*).

Dehiscence is generally apical in the persistent fruit and both apical and basal in the deciduous one, but there are instances of a stipitate, persistent pod opening first at base on the ventral side (sect. *Strigulosi*) or even through the base and stipe

(sect. *Hookeriani*). Dehiscence is apparently set in motion and its method determined by tensions internal to the ripening valve-walls and sutures; it is therefore governed by factors implicit in the pod's texture and compression, discussed above.

9. *Ecology and Dispersal.*—The majority of *Astragalus* species seem to exist in delicate balance with environment, their patterns of distribution no doubt determined by interplay of complex genetic and ecological factors. Few *Astragali* tolerate direct competition with other herbs, still fewer endure the shade cast by overhanging shrubs or trees. There are some mesophytic exceptions, such as *A. diversifolius, A. Lemmoni* and *A. argophyllus* var. *argophyllus,* species of xeric lineage which have made a successful adjustment to moist grassy habitats, and some halophytic varieties of *A. lentiginosus* and *A. Hornii,* which require moisture early in the year although capable of surviving long summer drought. An interesting relationship has developed between a number of xerophytic *Astragali* of the intermountain United States and the dwarf sagebrush, *Artemisia arbuscula* Nutt. (less commonly *A. tridentata* Nutt.), the gnarled branches of which provide shelter for the seedlings and later protect the tender stems and foliage from grazing animals. Several homaloboid sections have contributed to this group, which includes various *Miselli* and *Atrati, A. solitarius, A. pinonis,* and *A. bernardinus.* Nevertheless by far the greater number thrive only in situations inhospitable to a continuous ground cover or are confined to soils actually hostile to most plant life. Few of the prairie species can tolerate the sodgrass climax vegetation; most flourish only on the shaley ridges or gravel outcrops which here and there break through the gently rolling contours of the plains, and they congregate in variety and abundance only on gullied river banks or on breaks and badlands sculptured by erosion. The xeric tendency is so universal in the genus, both in the Old and New Worlds, that I can only think of it as a generic characteristic which must have been established at a very early period. The ability to survive and subsequently to require a difficult environment has enabled members of the genus to colonize a great variety of raw, newly exposed, often unpromising habitats. It is perhaps not over fanciful to imagine that it is this propensity, together with the selective action of new and exacting circumstances upon pioneer populations, that has set the stage for the proliferation of species and at the same time determined the patterns of narrow endemism which are a feature of the genus at large.

Endemism in *Astragalus* has numerous facets. Many of the narrowest endemics are restricted to a confining ecological niche: *A. ceramicus* to dunes in the interior, *A. anemophilus* to ocean dunes, *A. striatiflorus* to sand talus under cliffs, *A. ampullarius* to clay knolls, *A. lutosus* to white shale knolls, *A. lentiginosus* var. *sesquimetralis* to desert playa, *A. amblytropis* to volcanic talus, *A. panamintensis* to calcareous rock crevices, *A. monumentalis* to white sandstone rimrock, and *A. cremnophylax* to rimrock of hard, white, crystalline limestone; the list could be greatly extended. The range of others is delimited by the availability or absence of some particular mineral, as exemplified by the seleniferous, gypsophile, and obligately calciphile and calcifuge species. The maritime and insular Californian *Astragali* are bound to a narrow strip within a few miles of the ocean or within sound of the surf, whereas another type, exemplified by many prairie species, the Californian *A. Gambelianus,* or *A. Newberryi* in the Great Basin, may range over a variety of habitats within a relatively extensive floral province but scarcely transgress the provincial frontiers. Others of our rarest *Astragali* occur in what appears to be an unspecialized environment, but are for some reason unable, or perhaps have not yet had time, to expand into the ostensibly suitable terrain at their immediate disposal; *A. agnicidus, A. Tweedyi, A. Jaegerianus, A. oocarpus, A. uncialis,* and *A. lentiformis* exemplify this type. Some narrow endemics, such as *A. porrectus, A.*

panamintensis, A. lutosus, A. circumdatus, and *A. Brauntonii,* are taxonomically isolated, but the majority are vicariant or pseudovicariant with a more widely dispersed kindred species from which they very probably are derived. Examples of the latter sort are *A. accumbens,* satellite to *A. missouriensis, A. aequalis* to *A. pinonis,* and *A. Clarianus* to *A. Rattani.* It is worth noting that in each case a striking morphological specialization has coincided with the genesis of the newer species, in *A. accumbens* involving the flower, in *A. aequalis* the fruit, and in *A. Clarianus* both. Bicentric and more elaborately discontinuous patterns of distribution are uncommon among the North American *Astragali* of the 11–13-chromosome series: *A. filipes, A. Bodini, A. Paysonii, A. giganteus, A. Palmeri* (doubtful), *A. Hornii* (perhaps due to dissemination by birds), *A. distortus* var. *distortus, A. Pulsiferae* var. *Suksdorfii, A. acutirostris* (perhaps only apparent) virtually exhaust the list. Several at least of these nine species must have enjoyed at one time a wider range than they do today, but otherwise they have little or nothing in common. It is possible that the interrupted range may denote decline of vigor and inability to adjust to changing circumstances, which often characterize senescent species; but migration of whole floras, due to change of climate, might explain the gaps in the contemporary range of comparatively recent and still vigorous ones. Generally it is not possible to derive decisive evidence of age in a given species from considerations of range alone. Some of our ostensibly modern species, such as the adaptable *A. Purshii,* which has acquired in its light woolly pods an extremely efficient means of seed dispersal and is nowhere handicapped by bondage to a particular soil or environment, has an immense altitudinal and spatial range. On the other hand *A. accumbens* of the same section, listed above as almost certainly a recent derivative of *A. missouriensis,* is a spot endemic confined in its one known station to a peculiar type of gumbo clay soil. Since this species has also inherited from *A. missouriensis* an emmenoloboid pod which sheds its seeds only in the immediate vicinity of the parent plant, its prospects of spreading even to other isolated clay knolls is remote.

The remarks on dispersal up to this point are relevant only to those groups of *Astragali* which seem to be genuinely autochthonous in the sense that they and all their relatives are American, and presumably have developed over a very long period of time in isolation from their Asiatic congeners. The American species representing subgenera which have their centers of speciation and dispersal in Asia are, like *Oxytropis,* of a different order, both cytologically (having a basic 8 chromosome count) and in details of their American range. It is surprising, in the first place, that almost all of our most widely disseminated species are to be found in the ranks of these Asiatic outliers. The transcontinental and Cordilleran ranges of *A. alpinus* (sens. lat.), *A. americanus,* the two American *Oroboidei,* and *A. aboriginum,* like that of *Oxytropis campestris* (sens. lat.), *O. viscida* Nutt., and *O. podocarpa* Gray, are of a type readily recognized as shaped by glaciation. All are species adapted to moist, or if dry then cold, morainal or littoral habitats. They may have entered America, either in their present form or in the shape of scarcely different precursors, by way of the Behring land-bridge, in Pleistocene time; according to Hultén's view of the history of boreal plants, they must have had their origin or at least a temporary home in the Behringian region during the long interglacial period preceding maximum glaciation. Only one *Astragalus* of the American homaloboid series, the bicentrically dispersed, boreal and Cordilleran *A. Bodini,* which is adapted to cold moist shores and streamsides, has a range at all similar. A smaller group derived from Asiatic sources, quite heterogeneous in content except that all members are characterized by a dense inflorescence and erect, fully bilocular pods, is made up of the three species *A. agrestis, A. adsurgens,* and *A. canadensis,* the

first having an amphi-Pacific range, the second represented by endemic varieties in each continent, the last American but with close Asiatic kindred. All three are temperate rather than arctomontane elements in our flora, and the same is true of their representatives or counterparts in the Old World. The passage of the relatively xerophytic *A. adsurgens* through Behringia is still marked by the survival of a relic var. *tananaicus* in (or near) the glacial refugium of the Yukon Valley, and the scattered records of the decidedly mesophytic *A. agrestis* from the same region may also denote the persistence of relictual populations cut off by the ice sheets from the main range of the species. The contemporary dispersals of *A. canadensis* and its Siberian analogue *A. uliginosus* L., each of which has achieved an extensive range through a variety of moist habitats mostly at low elevations, lie far to the south of the Arctic Circle, and the connection between the two may go back into Tertiary time. The fact that *A. canadensis* has differentiated into three substantial geographic races since its establishment in America and has even given rise, in *A. oreganus,* to an endemic, xerophytic descendant, suggests a longer residence in our continent. It would be reasonable to suppose that *Oxytropis,* which has also penetrated far south in temperate western (*O. Lambertii* var. *Bigelovii* into arid subtropical) North America and, furthermore, has given rise in *O. multiceps* Nutt., *O. Lagopus* Nutt., *O. oreophila* Gray, and *O. Jonesii* Barneby to highly specialized novel types adapted to extremely dry conditions, obtained an initial foothold in America before the onset of glaciation in the Quaternary. The range of *A. Wrightii,* an advanced annual species endemic to eastcentral Texas which seems nevertheless to have its closest affinities in central Asia, raises enigmatic problems of plant migration and floristic relationships to which no solution can be attempted.

The successful passage into America from Asia of at least seven different types of *Astragalus,* whenever this occurred, raises the interesting question of why there was no reciprocal exchange of species in this genus while the avenues of migration were open. For there is no evidence that any American member of the 11–13-chromosome series ever reached or at least ever survived in Asia[2]. It is surmised that the prototypes of the autochthonous American species-groups were of subtropical arid origin, ill-adapted to high latitudes at the time that migration routes west into Asia were open. The climate which permitted the eastward passage of types already adapted to moist and cold conditions could have proved a barrier to xerophytes. In this connection it is worth noting the extreme paucity of alpine *Astragali* in North America as compared with the Pamirs, Karakoram, Hindu Kush, Tien Shan, or the Sino-Tibetan highlands. Apart from species of the 8-chromosome series, already noted as immigrants from Asia, one encounters above timber line in the Rocky Mountains only *A. molybdenus,* whose chromosome complement and relationships are unknown, and the definitely homaloboid *A. Bourgovii* and *A. Kentrophyta,* both of which occur also in lowland habitats. The genus shuns the high Cascades completely, and the few species found at truly alpine levels in the Sierra Nevada either are, like *A. Kentrophyta* var. *danaus* or varieties of *A. lentiginosus, A. Purshii,* and *A. Whitneyi,* merely high-montane races of predominantly lowland types, or, like *A. Austinae* and *A. Ravenii,* have a close relative and probable precursor near at hand in the Sierra's eastern foothills. Two Basin *Astragali, A. platytropis* and *A. calycosus,* sometimes accompanied by *Oxytropis oreophila* Gray, are composed of genuinely alpine as well as lowland populations, the latter mostly confined to highly specialized knoll environments in the inter-

[2] As noted elsewhere, under sect. *Polares,* the description of *A. salicetorum* Kom., a Kamtchatkan endemic treated in Flora U. R. S. S. as though greatly isolated taxonomically in the Asiatic flora, is suggestive of our *A. Bodini* or of a close relative. I have seen no specimen.

mountain valleys; but none of these have alpine relatives and their occurrence above timber line is probably secondary. The *Strigulosi* found near the 12,000-foot contour on the volcanoes of the Mexican Plateau and Guatemala are unquestionably derived from kindred types native to the pine belt of the middle slopes. From the morphological viewpoint our four arctoboreal *Astragali* of the homaloboid series which form the sects. *Polares* and *Gynophoraria* are highly advanced and specialized, and it seems probable that their adaptation to high latitudes and invasion of tundra habitats are comparatively recent.

Space does not permit more detailed examination of many suggestive fine points brought out in the distribution maps scattered through the Atlas; but enough has been said to show that study of dispersal alone is of little real help in determining the probable age of a species, even though it may sometimes throw light on origin in particular contexts. After a general survey of *Astragalus* as developed in western North America, Jepson (1936, p. 343) characterized the genus as one "of ancient lineage which has long inhabited the area that it now occupies, and whose evolutionary tendencies have become relatively fixed by isolation and adaptation." This view is certainly borne out by comparative study of the morphology and dispersal of what I have called the autochthonous groups, but must be modified if the immigrants from Asia are included. The perceptibly different styles of dispersal in the autochthonous and immigrant groups should not be surprising if the two groups, as surmised, have had a long separate history; and confirmed by what cytological evidence is available, the taxonomic separation of the Old and New World elements in our astragaline flora seems amply justified thereby, even though clear morphological evidence for such a separation is lacking.

A NEW SYSTEM FOR NORTH AMERICAN ASTRAGALUS

The reader who has followed the discussion of phylogenetic theory will realize that the path to a systematic arrangement of North American *Astragali,* which will combine utility with even an appearance of naturalness, let alone the genuine article, is a dark and devious one, beset by problems and ambiguities and only fitfully illuminated here and there by a gleam of fact or reason. The system presented in the following pages has gone through several experimental forms and is obviously capable of refinement. My primray interest lay in the delimitation of the individual species, but as familiarity with these increased, I experienced growing dissatisfaction with many of the higher groups assembled by Jones and Rydberg, and I began to question the reality behind a taxonomic structure built up primarily on characters of the fruit, which these authors had inherited from Gray. I was persuaded that interpretation of *Astragalus* evolution in terms of the pod had come to reflect less of a desire to understand a complex natural order than an effort to impose on Nature an order more readily comprehensible to the human mind; it was the old Procrustean device of shaping the foot to fit the shoe. It seemed unlikely, furthermore, that a valid system could be worked out for *Astragalus* in North America which left completely out of account the development of the genus in eastern Asia or South America. Accordingly I began to look into the possibilities of extraterritorial relationships and to feel my way toward a system, coordinate with that already in use in the Old World, which would rest on broader foundations than any envisaged hitherto. The Atlas is the outcome of this inquiry.

Contrary to what is sometimes supposed by persons dismayed by the sheer number of existing *Astragali,* the species of the genus are, as a rule, separated by easily found and easily defined morphological discontinuities. The majority may be recognized, once known, by an idiosyncratic facies which does not depend on the

presence of ripe fruit; and the reality of most is confirmed by a natural, usually continuous range which only rarely overlaps that of close kindred. Like all large genera, *Astragalus* has its critical and taxonomically difficult groups, of which the *A. lentiginosus* complex is the most vexatious in North America; and it embraces constellations of taxa which, although sharply defined geographically (like many of the *Aridi*), are separated by only small and relatively trivial technical characters, inviting controversy over the appropriate taxonomic category. Happily, however, these are in a decided minority. The delimitation of sections and of higher infrageneric categories is much more difficult than definition of species. The orthogenetic impulse toward mutation inherent in the gene stream of the genus seems to have expressed itself not only in several directions simultaneously, but also in the same or parallel directions at different levels of time and at different levels of evolutionary progress. As a result the genus, at least in North America, is rich in ambiguous analogies, and an objective criterion of affinity applicable to all situations is lacking. In the Old World Bunge was able, in the main successfully, to divide nearly a thousand taxa into eight grand subgeneric divisions, using characters of root-duration, hair-attachment, type of inflorescence, and floral morphology, but nothing of that kind is possible in America. Applied to our species, the characters useful in the Old World cut straight down the middle of obviously natural species-groups and in several cases sever one or more varieties or forms of a species from the rest. So far as can be determined, there is no single feature which serves to divide the North American *Astragali* even into two categories without doing violence to a natural arrangement; and I feel sure that if a decisive dichotomy existed, it would not have escaped notice until now. Rydberg defined his segregate genera by means of arbitrary fruit-characters and then proceeded to assemble within them any or all species which matched the preconceived generic diagnosis, regardless of other morphological characters or of geographic probabilities. In the name of consistency he was compelled to assign to different genera aspects of single species (e.g., *Hamosa drepanoloba* and *Phaca diurna* = *A. diaphanus; Tium oxytropoides* and *Cnemidophacos Knowlesianus* = *A. hoodianus*) because of a small variation from one plant to the next in the width of the pod's septum. Jones avoided such excesses because he knew his species in the field, but his sections were still formed fundamentally after the same pattern and are often heterogeneous in content for the same reasons.

The sections that appear in this Atlas have been built around a nucleus of one, or at best of a few obviously similar types, and their limits determined by what appear to be important breaks or discontinuities involving more than one of those characters which experience has shown to be significant in the context of the genus. Definition of the section has not preceded but followed its recognition as such, for I have aimed to apply to this category the Linnaean precept that the character does not make the species but vice versa. I have admitted to the section only such elements as seemed genuinely close kindred, for the inclusion of dubious or aberrant ones might imperil the soundness of the entire taxonomic edifice. As a result, the sections in the Atlas are smaller and more numerous than in Jones's Revision, and honest doubts have compelled me to recognize a possibly excessive number of monotypic ones. However, taxonomically isolated species are characteristic of *Astragalus,* in the Old and New Worlds alike, and for most of the monotypic sections no apology need be made.

If the definition of sections calls for an enlightened judgment, the next step, that of convening the sections into higher categories which might correspond with the Old World subgenera of Bunge and at the same time give expression to a genuine phylogeny, requires something akin to mystical perception. While he is

dealing in terms of sections, the taxonomist working with American *Astragalus* remains in touch with directly observed facts; but as he advances into the realm of higher categories, he encounters concepts increasingly nebulous and hypothetical. I have sometimes wondered whether any real purpose is served by flight at such Icarian altitudes. A system of classification, except in its purely utilitarian aspect, is no sounder than the assessment of relationships on which it is based, and relationship in the plant kingdom, whether we like it or not, is perceived more intuitively than by conscious reasoning. Reason is the handmaiden of imagination, and it is only, perhaps, by daring to fly and to risk burned plumage that one can hope to reach out toward distant truths. The novel arrangement of species and sections in the Atlas expresses an admittedly imperfect view of the course that evolution may have followed in bringing forth to the observer's grateful and astonished eye the marvelously diverse *Astragali* which decorate the hills and deserts of the North American continent. It requires the refinement that time, use, and cytological evaluation can bring to it, but I shall feel satisfied if it serves as a springboard for advances in the general taxonomy of the genus.

Before proceeding to the synopsis and a brief explanation of it, I should like to summarize the probable sequences in which various organs of *Astragalus* and *Oxytropis* are believed to have been modified; these sequences, together with the cautionary statements modifying them, form the rational basis of the system.

1. The herbaceous perennial gave rise to the annual and shrubby types.
2. Connate stipules, at least in recent time, precede free ones.
3. A loosely racemose inflorescence is primitive to densely racemose, spicate, subumbellate, or capitate ones.
4. A nodding flower and pendulous pod precede an ascending or erect flower and fruit.
5. A campanulate calyx and relatively short-clawed petals precede a cylindric calyx and long-clawed petals.
6. An emmenoloboid pod precedes a piptoloboid one, and at the same time a deciduous pedicel precedes one which becomes thickened and persists with the fruit.
7. A papery pod precedes a membranous, leathery, fleshy, or pithy one.
8. A trigonous mode of compression gives rise, either with or without a septum, to laterally flattened, dorsiventrally flattened, or terete (or more elaborately modified) types.
9. Although the septum is assumed to be an acquired character, no inferences can be drawn from its presence or absence in contemporary North American species.
10. Each of these sequences has occurred independently in various lines of inheritance; each is subject to reversal.
11. A chromosome complement in multiples of 8, the number commonest among the *Galegeae,* gave rise, possibly by means of reduction subsequent to tetraploidy, to the higher numbers prevalent in America; but no identifiable external morphological change accompanied this cytological development.

INTRODUCTION TO THE SYSTEM

The North American species are thought to represent seven major phylogenetic branches of the genus. No mutually exclusive terms can be found to define these branches, and for this reason they are not described or named as subgenera, even though they are believed to be of the same order as the subgenera recognized in the Old World. As a substitute for the *subgenus* of Bunge I employ the term *phalanx,* borrowed from Pallas (1800) who used it in a similar context. It serves as a handy term of reference, but remains outside the domain of formal nomenclature.

Of the seven phalanxes, four are equivalent to Asiatic subgenera, which have contributed about fifteen species to the astragaline flora of North America. They include the most primitive and also some of the more advanced Old World sections and, incidentally, the majority of the most widely dispersed species. The bulk of the autochthonous *Astragali* are divided between the almost equally extensive Homa-

loboid and Piptoloboid phalanxes. The latter is the more advanced of the two; it contains the majority of the taxonomically difficult groups and runs out at several independent points into sections of annual or partly annual forms. Finally, the small, also American *Orophaca* phalanx, composed of two sections and seven highly modified species, brings up the rear. The phalanxes are characterized and further divided into series as follows:

A. *The Phacoid Phalanx.*—This is thought to be the most primitive phylum within *Astragalus.* Its center of speciation lies in the mountain masses of Chinese and Russian Turkestan from which it has spread out into Europe and North America, and by way of the Afghan Plateau and the Abyssinian highlands into the mountains of tropical Africa. The American members are relatively advanced types and may be divided into genuine *Phacae,* with free stipules and unilocular pods, and genuine *Astragali,* with united stipules and at least a partial septum in the pod. The basic syndrome of characters in this phalanx is a pendulous, stipitate, persistent pod of papery texture, nearly always few-ovulate, combined with chromosomes in multiples of 8. The majority are mesophytes with relatively few leaflets of thin texture and loose racemes of nodding flowers. The most highly advanced Phacoid section in America is *Hemiphaca,* in which the pod has become not only erect and sessile, but also deciduous. The monotypic sect. *Minerales* is introduced here because of its general similarity to *Astragalus,* sens. str.; but its chromosome number is unknown, and it may belong among the aberrant piptoloboid groups in the next phalanx, conceivably near sect. *Polares.* Polyploidy, a rare phenomenon so far as known in most groups of *Astragalus,* is a common one in the boreal species of this phalanx.

B. *The Homaloboid Phalanx.*—The largest phylum of autochthonous origin, embracing 46 sections and 177 species. It is entirely North American, with possible exceptions of *A. salicetorum* in Kamtchatka and *A. Chamissonis* (Vog.) Reiche in South America, and has the same basic syndrome of characters as the preceding except for chromosome number. It differs principally from the almost equally extensive Piptoloboid phalanx in having a persistent pod, the exceptions to this rule belonging to highly advanced sections which have, however, preserved the facies and connate stipules of homaloboid types. The phalanx is divided into five series arranged so far as practicable in an order of increasing specialization. At the bottom we find the (*) *Genuine Homalobi* with a pod for the most part unilocular, varying from terete to variably compressed, although the first sections in order, which owe their position to their close resemblance to some Phacoid types, have variably septate fruits. A culminating point is reached in the acaulescent *Drabellae* which combine an erect pod with dolabriform hairs; by passing this diversion, the *Collini* and their relatives are reached which preserve the hanging pod but have developed free stipules, and the *Hookeriani* which preserve the united stipules but have developed a bladdery-inflated pod. At the end the small but highly modified sect. *Ervoidei* passes out into forms with pod at first sessile and finally deciduous as well. The (**) *Piptoloboid* series of *Homalobi* follows. The members are homaloboid in facies and in connate stipules, but the pod is sessile and deciduous as in the advanced *Ervoidei* just mentioned. It is probably an artificial division, for it includes both advanced xerophytic and advanced mesophytic sections, all of them of debatable kinship. Reaching the (***) *Seleniferous Homalobi,* the normal order is inverted to bring the *Ocreati* into contact with the similarly piptoloboid *Humistrati* of the preceding series. Except in the *Ocreati* the pod here is persistent, at first pendulous and thin-textured, in later groups thick-textured and often erect, always unilocular. The unity of this series is perceived through a common adaptation to

selenium, although the members are not the only seleniferous *Astragali* in North America. The (****) *Tioid Homalobi* resemble the first series except that the pod is bilocular and the stipules more often free than united. The pods are pendulous, or if ascending also humistrate. The (*****) *Arrect Homalobi* resemble the last except that the pod is stiffly erect. Toward the end of this series we introduce some taxonomically isolated species having in common an erect, persistent pod, sometimes unilocular, sometimes bilocular, the stipules (in sects. XLV–XLIX) connate, or (in sects. L–LII) free. The last section but one *(Preussiani)* contains the remaining seleniferous species, and at the end we place the anomalous mesophytic *A. neglectus,* technically similar by some unknown convergent path.

C. *The Cercidothrix Phalanx.*—The two sections (three species) of this Old World subgenus are outliers of an immense, highly diversified group of sections characterized by a perennial root and dolabriform vesture, which extends from central and southern Europe east to Japan, the species and the variety of types most numerous in central Asia. American members have connate stipules, dense spiciform racemes of either nodding or erect flowers, and erect bilocular pods. They differ from the Arrect *Homalobi,* which they resemble in facies, in the connate stipules and the chromosomes in sets of 8 or 16.

D. *The Hypoglottis Phalanx.*—An Eurasiatic group, like the last in range but of much smaller size, possibly artificial, as it differs technically only in the basifixed vesture. The one American species, native also to eastern Asia, belongs to a section of mesophytic species, twenty or more in number, extending from western Europe into Siberia, but apparently centering in the Caucasus, northern Iran, and eastern Turkey. It is isolated in this flora.

E. *The Piptoloboid Phalanx.*—The second largest North American phylum within the genus, composed of 35 sections and 170 species, and a few more in South America. Like the *Homalobi,* it can be divided advantageously into series. The basic syndrome of characters is a deciduous pod combined with free stipules and chromosomes in sets of 11–14. The differentiation of the *Piptolobi* starts at the level of specialization reached here and there by some advanced *Homalobi,* but it does not seem to proceed from any one or more of these evolutionary eminences. Apparently it represents an independent line of development, one which has given rise to a dazzling array of elaborately modified fruiting structures. In order to bring out the Texan and Californian annual groups toward the end of the sequence where they seem to belong, it has been necessary to invert the order of floral specialization, starting with the (*) *Large-flowered Piptolobi,* characterized by a cylindric calyx-tube and long-clawed petals. In this series the flowers are with few exceptions erect and the pods very often humistrate and ascending. In some *Megacarpi* the calyx-tube has reverted to a campanulate form, even though the long claws of the petals, now greatly exserted, have survived. The sect. *Desperati* presents flowers of two sorts, one relatively long and narrow, one shorter and broader, therefore technically similar to the Small-flowered *Piptolobi,* but it is introduced here because of its probable relationship to the *Argophylli.* Development of a septum in the pod of this series is irregular and erratic; it is absent from sects. *Pterocarpi* and *Lutosi,* from some *Desperati,* and from the majority of the *Argophylli* and *Megacarpi,* but present and often very broad in the rest. The compression of the generally more or less fleshy or pithy (in some *Megacarpi,* the *Desperati,* and *A. lutosus,* papery) pod is predominantly trigonous and dorsiventral, lateral in only a few extraordinary *Argophylli,* becoming in *A. pterocarpus* peltiform and in *A. tetrapterus* four-angled

as the valve tissue shrinks. The range of the Large-flowered *Piptolobi* lies almost entirely in the United States west of the Mississippi, only three species (*A. tennesseensis,* the Mexican *A. Helleri* and *A. sanguineus*) and some varieties of *A. mollissimus* being endemic outside this area; only one species *(A. Purshii)* extends east of the Sierra axis into cismontane California proper. The series that I have called the (**) *Pacific Piptolobi* present a peculiar problem in classification. The feature common to its members, all relatively coarse, cismontane, often maritime species of California and northern Baja California, is an inflated, unilocular pod, commonly bladdery and of obscure trigonous or dorsiventral compression, but in one species sometimes strongly flattened sideways in the *Homalobus* style. Since at the same time the stipules vary from connate to free, some members of the series present almost perfect piptoloboid, others almost perfect homaloboid sets of morphological characters, although the flowers are mostly of a long, narrow type, a feature not ordinarily homaloboid. The unity of the series is perceived through resemblances which can be followed from species to species, and is confirmed by adaptation of its members to an almost Mediterranean climate and a comparatively small area of high endemism. These vexatious sections are thought to be recombination types issuing from anastomosis of Homaloboid and Piptoloboid lines of inheritance. The series is introduced at this point because the often long flower resembles that of the preceding series, whereas the bladdery pod is common to most members of the *Inflati,* the first section of the series next in order. The (***) *Small-flowered Piptolobi* are assembled around the nucleus of the *Inflati* and *Diphysi,* which are perhaps no more than unilocular and bilocular aspects of one group. Immediately following these are four small mutually isolated sections which have either preserved or reacquired connate stipules. Except that the pod is bilocular in almost all of these, they might be referred to the Piptoloboid *Homalobi;* their relationships are really unknown. The *Inflati* are represented in southeastern United States by the *Villosi,* in which the pod remains little inflated and acquires a deep dorsal sulcus, presaging the hamosoid type found in the following series. The last three groups of Small-flowered *Piptolobi* are again taxonomically isolated. The monotypic *Lotiflori* combine the small flower of short, blunt type with the fruit nearly of the *Argophylli* and dolabriform vesture. The monotypic Sect. *Panamintenses* is quite anomalous in this context and may belong near the Tioid *Homalobi* despite its deciduous fruit. The *Humillimi,* a very highly modified group of subacaulescent species, with partly basifixed and partly dolabriform vesture, and very small, few-seeded, unilocular pods, are again homaloboid in facies but have lost the decisive technical features of that phalanx. The arrangement of sects. LXXI through LXXVIII is in general unsatisfactory and will doubtless require modification. The dispersal of the Small-flowered *Piptolobi* is of the same general character as described for the preceding series, though the species become more frequent toward the Southwest, and the *Inflati* have an important extension into Baja California. The (****) *Hamosoid Piptolobi* are of yet more southern, almost subtropical character, their main theaters of speciation being the Great Valley of California, the Mohave and Sonoran Deserts, Texas, and Mexico north of the transverse volcanic belt, with only a few outliers northward in the Great and Columbia Basins. Their basic character is a narrow, trigonous pod often incurved into the form of a bow or sickle, but this has been adapted by means of inflation, dorsiventral compression, or reduction in length and ovule-number, into a variety of remarkable forms. Except for the greatly isolated *A. succumbens,* the flower is always of the short type, with campanulate calyx-tube. Dolabriform hairs make independent appearances in one member of sect. *Leptocarpi* and in the monotypic, acaulescent *Scaposi.* In the *Micranthi* the hamosoid pod, mostly erect up to this point, becomes

deflexed. In the monotypic *Hypoleuci* connate stipules are found, here possibly a legacy from a sympatric Mexican precursor of homaloboid origin. This same feature reappears in the majority of sect. *Chaetodontes,* an internally heterogeneous group which is both geographically isolated from the other hamosoid types and lacks obvious genetic connections with them. The *Chaetodontes* are introduced here because their usually small, much-reduced pods are nevertheless of the hamosoid pattern; they present several individual specializations of an unusual order, the genuine *Chaetodontes* a spicate inflorescence and tumid calyx enclosing the fruit, *A. Lemmoni* an adaptation to moist alkaline habitats, *A. Austinae* pubescent petals. The taxonomically isolated *A. Brauntonii* accompanies the *Chaetodontes* because of a similarity in the highly modified inflorescence to that of *A. Spaldingii* of subsect. *Chaetodontes.* It is an extremely rare species of the southern California chaparral belt and has no close surviving relative. The last four sections contain our most advanced annual types, all Californian and Texano-Mexican, with free stipules; in each the pod has achieved an independent evolutionary climax.

F. *The Trimeniaeus Phalanx.*—The one American member of this otherwise Old World group, most highly developed in the Mediterranean Basin and Near East, is a Texan annual with minute flowers held more or less erect in subcapitate heads, and erect, persistent, bilocular pods of the hamosoid type.

G. *The Orophaca Phalanx.*—Of all the genera carved out of *Astragalus,* Nuttall's *Orophaca* is perhaps the best characterized, its large, hyaline stipules, trefoil leaves clothed with long, lustrous, dolabriform hairs, and small, unilocular pods forming an unique combination. The phalanx consists of two sections, one with short, spreading flowers, often pedunculate, the other with long, narrow flowers sessile in the leaf-axils of an acaulescent tuft. Transitions between them are still extant, so that the course of evolution is revealed. The small-flowered group suggests some *Homalobi* in the flower and in the simplified few-ovulate pod, but the long-flowered, genuine *Orophacae* have reached an evolutionary level comparable to that of the piptoloboid *Argophylli.* This small but instructive phalanx forms an independent branchlet of the astragaline tree, in some respects primitive, in others highly advanced. Its center of speciation lies on the high plains and Cordilleran foothills in Wyoming and adjoining states drained by the North Platte and upper Missouri Rivers. The last two *Orophacae* are the only species in the New World to acquire the peculiar platyonychious banner which has made independent appearances in the flower of several Asiatic groups. In the last species the petals are in addition pubescent.

Synopsis of the North American Species

(Note: the two highest categories, the phalanx, A, B, etc., and series, set off by asterisks, have no nomenclatural status. The rest are distinguished as follows, in descending order: *Sectio,* in CAPITALS, numbered in large Roman numerals; *subsectio,* in Capitals and Small Capitals, numbered successively in small Roman numerals in parentheses; *species,* numbered in Arabic numerals; *varietas,* lettered. Only *basic* characters are indicated under phalanx and series, and only the more important exceptions noted opposite lower taxa at right.)

A. The Phacoid Phalanx (Sects. I–VI)

Pod mostly pendulous, often stipitate, persistent on the receptacle, the valves of thin texture; raceme loose, the flowers mostly nodding; n = 8, 16, and higher multiples of 8; species largely Old World.

*The genuine *Phacae.*—Stipules free; pod unilocular. Includes *Phaca* L., sens. str., *Phaca* subgen. *Podocystis* Rydb., sens. str., *Astragalus* subgen. *Phaca* Bge., p.p. (Sect. I).

I. Sect. PHACA

1. *A. umbellatus* (2n = 16)
2. *A. americanus* (2n = 16)

**The genuine *Astragali.*—Lower stipules connate; pod semibi- or subunilocular. Includes *Astragalus* L., sens. str., *Astragalus* subgen. *Phaca* Bge., p.p., *Atelophragma* Rydb., p.p. (Sects. II—VI).

II. Sect. ASTRAGALUS

3. *A. alpinus* (2n = 16, 32 "± 56")
   a. *alpinus*
   b. *Brunetianus*
4. *A. leptaleus*

III. Sect. MINERALES

5. *A. molybdenus*

(Pod sessile humistrate)

IV. Sect. OROBOIDEI

6. *A. eucosmus* (2n = 16, 32)
7. *A. Robbinsii*
   a. *minor* (2n = 16, 32)
   b. *occidentalis*
   c. *alpiniformis*
   d. *Robbinsii*
   e. *Jesupi*
   f. *Fernaldi*
   g. *Harringtonii*

V. Sect. HEMIPHRAGMIUM

8. *A. aboriginum* (2n = 16, 32)
9. *A. Cottoni*

VI. Sect. HEMIPHACA

10. *A. Williamsii*

(pod erect, sessile deciduous)

B. The Homaloboid Phalanx (Sects. VII–LII)

Pod as in the preceding; n = 11, 12. American

*The genuine *Homalobi.*—Pod with rare exceptions both pendulous and persistent; stipules connate, or if free the pod unilocular (Sects. VII–XX; cf. also Sects. XXVI–XXVII). Includes *Atelophragma* Rydb., p.p., *Pisophaca* Rydb., *Homalobus* Nutt., *Lonchophaca* Rydb., *Kentrophyta* Nutt.

VII. Sect. STRIGULOSI

11. *A. guatemalensis*
    a. *guatemalensis*
    b. *brevidentatus*
    c. *Lozani*
12. *A. legionensis*
13. *A. Hintoni*
    a. *Hintoni*
    b. *cofrensis*
14. *A. tolucanus*
15. *A. strigulosus*
16. *A. Lyonnetii*
17. *A. radicans*
    a. *radicans*
    b. *Harshbergeri*
18. *A. potosinus*
19. *A. zacatecanus*
20. *A. jaliscensis*
21. *A. regiomontanus*
22. *A. Pennellianus*

(Pod semibilocular except in 27 and 35)

23. *A. tioides*
24. *A. altus*
25. *A. hidalgensis*
    a. *hidalgensis*
    b. *protensus*
26. *A. Purpusi*
27. *A. pueblae*
28. *A. recurvus*
29. *A. Rusbyi*
30. *A. longissimus*
31. *A. Egglestonii*
32. *A. micranthus*
    a. *micranthus*
    b. *Seatoni*
33. *A. esperanzae*
34. *A. cobrensis*
    a. *cobrensis*
    b. *Maguirei*
35. *A. microcymbus*

VIII. Sect. SCALARES

36. *A. scalaris*

IX. Sect. TIOPSIDEI

37. *A. scopulorum*

(Pod fully bilocular)

X. Sect. SCYTOCARPI

X (i). SCYTOCARPI

38. *A. flexuosus*
    a. *flexuosus* (2n = 22)
    b. *Greenei*
    c. *Diehlii*
39. *A. pictiformis*
40. *A. proximus*
41. *A. fucatus*
42. *A. subcinereus*

X (ii). WINGATANI

43. *A. wingatanus*

X (iii). MICROLOBI

44. *A. gracilis*

X (iv). ANTONINI

45. *A. coriaceus*

X (v). HALLIANI

46. *A. Hallii*
    a. *Hallii*
    b. *fallax*
47. *A. puniceus*
    a. *puniceus*
    b. *Gertrudis*
48. *A. Castetteri*

XI. Sect. GENISTOIDEI

49. *A. miser*
    a. *oblongifolius*
    b. *tenuifolius*
    c. *serotinus*
    d. *hylophilus*
    e. *miser*
    f. *praeteritus*
    g. *decumbens*
    h. *crispatus*
50. *A. convallarius*

(Pod sessile)

a. *convallarius*
b. *finitimus*
c. *scopulorum*
51. *A. diversifolius*

XII. Sect. LONCHOCARPI

XII (i). Pseudogenistoidei
52. *A. titanophilus*
53. *A. xiphoides*

XII (ii). Pseudoscytocarpi
54. *A. Cronquistii*

XII (iii). Aequales
55. *A. pinonis*
56. *A. aequalis*

XII (iv). Lancearii
57. *A. Episcopus*
58. *A. lancearius*
59. *A. duchesnensis*
60. *A. nidularius*
61. *A. Harrisonii*

XII (v). Lonchocarpi
62. *A. Coltoni*
a. *Coltoni*
b. *moabensis*
63. *A. Ripleyi*
64. *A. Schmollae*
65. *A. lonchocarpus* (2n = 22)
66. *A. Hamiltoni*

(Stipules free)

(Pod stipitate)

XIII. Sect. DRABELLAE
67. *A. spatulatus* (2n = 24)
68. *A. chloödes*
69. *A. drabelliformis*
70. *A. simplicifolius*
71. *A. detritalis*

(Pod erect-ascending, sessile; vesture dolabriform)

XIV. Sect. SOLITARII
72. *A. alvordensis*
73. *A. solitarius*
74. *A. Applegatii*

XV. Sect. CAMPTOPODES
75. *A. camptopus*

XVI. Sect. COLLINI
76. *A. collinus*
a. *collinus* (2n = 24)
b. *Laurentii* (2n = 24)
77. *A. curvicarpus*
a. *curvicarpus*
b. *brachycodon*
c. *subglaber*
78. *A. Gibbsii*

(Stipules free)

(Pod leathery)

XVII. Sect. TWEEDYANI
79. *A. Tweedyi*

(Pod erect)

XVIII. Sect. PODOSCLEROCARPI
80. *A. sclerocarpus* (2n = 22)
81. *A. sinuatus*
82. *A. speirocarpus*

XIX. Sect. CUSICKIANI

XIX (i). INVERSI

83. *A. filipes* (2n = 24)
84. *A. inversus*
85. *A. californicus*

XIX (ii). CUSICKIANI

86. *A. Cusickii*
    a. *Cusickii* (2n = 22)
    b. *flexilipes*
87. *A. Whitneyi*
    a. *Whitneyi*
    b. *lenophyllus*
    c. *siskiyouensis*
    d. *Sonneanus*
    e. *confusus*

XIX (iii). PICTI

88. *A. sterilis*
89. *A. ceramicus*
    a. *filifolius*
    b. *apus*
    c. *ceramicus*

(Pod inflated)

XX. Sect. ERVOIDEI

XX (i). ERVOIDEI

90. *A. tenellus* (2n = 24)
91. *A. vexilliflexus*
    a. *vexilliflexus*
    b. *nubilus*
92. *A. Bourgovii*

(Pod persistent, sessile in 91)

XX (ii). MICROCYSTEI

93. *A. microcystis*

XX (iii). SUBMONOSPERMI

94. *A. Kentrophyta*
    a. *implexus*
    b. *danaus*
    c. *Kentrophyta* (2n = 24)
    d. *Douglasii*
    e. *Jessiae*
    f. *ungulatus*
    g. *neomexicanus*
    h. *elatus*
    i. *coloradoensis*

(Pod sessile, deciduous)

**The piptoloboid *Homalobi*.—Like the preceding, but the pods humistrately ascending or spreading, sessile, deciduous; stipules always connate (Sects. XXI–XXIV).

XXI. Sect. POLARES

95. *A. Bodini* (2n = 24)
96. *A. polaris* (2n = 24)

XXII. Sect. GYNOPHORARIA

97. *A. nutzotinensis* (2n = 22)

(Long gynophore)

XXIII. Sect. JEJUNI

98. *A. jejunus*
99. *A. limnocharis*

(Pod ± pendulous, bladdery)

XXIV. Sect. HUMISTRATI

XXIV (i). HUMISTRATI

100. *A. humistratus*
    a. *humistratus*

b. *sonorae*
c. *humivagans*
d. *Hosackiae*
e. *tenerrimus*
f. *crispulus*
101. *A. sesquiflorus*

(Vesture dolabriform)

XXIV (ii). MICROMERII

102. *A. micromerius*
103. *A. tegetarioides*

(Vesture basifixed)

***The Seleniferous *Homalobi*.—Stipules connate and pod unilocular, persistent in all but the first section, stipitate or sessile, erect or pendulous (a polymorphic group); adapted to and mostly confined to selenium-rich soils (Sects. XXV–XXX).

XXV. Sect. OCREATI

XXV (i). OCREATI

104. *A. flavus*
a. *flavus* (2n = 24)
b. *candicans*
c. *argillosus*
105. *A. sophoroides*

XXV (ii). MOENCOPPENSES

106. *A. moencoppensis*

(Pod erect, sessile, deciduous)

XXVI. Sect. ALBULI

107. *A. albulus*

XXVII. Sect. BISULCATI

108. *A. bisulcatus*
a. *bisulcatus* (2n = 24)
b. *Haydenianus* (2n = 24)
c. *nevadensis*
109. *A. racemosus*
a. *racemosus* (2n = 24)
b. *longisetus*
c. *Treleasei*

(Pod pendulous, persistent, stipitate)

XXVIII. Sect. OOCALYCES

110. *A. oocalycis* (2n = 24)

(Calyx inflated)

XXIX. Sect. PECTINATI

XXIX (i). PECTINATI

111. *A. pectinatus* (2n = 22)
112. *A. Nelsonianus*
113. *A. Grayi* (2n = 44)
114. *A. toanus* (2n = 22)
115. *A. linifolius*
116. *A. rafaelensis* (2n = 22)
117. *A. saurinus*

XXIX (ii). OSTERHOUTIANI

118. *A. Osterhouti* (2n = 22)

(Pod leathery, erect in 113–115, 119, stipitate in 118, otherwise sessile and deflexed)

XXX. Sect. WOODRUFFIANI

119. *A. Woodruffi*

(Stipules free, foliaceous)

****The Tioid *Homalobi*.—Pod persistent, mostly pendulous and bilocular; stipules mostly free. Includes *Tium* sensu Rydb. p. max. parte, *Onix* sensu Rydb. (Sects. XXXI–XLI).

XXXI. Sect. MISELLI

120. *A. Congdoni* (2n = 26)
121. *A. agnicidus*

122. *A. umbraticus*
123. *A. Paysonii*
124. *A. ervoides*
    a. *ervoides*
    b. *Maysillesii*
125. *A. sinaloae*
126. *A. carminis*
127. *A. straturensis*
128. *A. Howelli*
129. *A. Arthuri* (2n = 24)
130. *A. misellus*
    a. *misellus*
    b. *pauper*
131. *A. oniciformis*
132. *A. toquimanus*

XXXII. Sect. NEVINIANI

133. *A. Traskiae*
134. *A. Nevinii*

XXXIII. Sect. NEONIX

135. *A. Mulfordae*
136. *A. Johannis-Howellii*
137. *A. Peckii*

(Stipules connate)

XXXIV. Sect. ATRATI

138. *A. atratus*
    a. *atratus*
    b. *owyheensis*
    c. *inseptus*
    d. *mensanus*
139. *A. salmonis*

XXXV. Sect. QUINQUEFLORI

140. *A. Brandegei*
141. *A. quinqueflorus*

XXXVI. Sect. INYOENSES

142. *A. inyoensis*

XXXVII. Sect. JAEGERIANI

143. *A. Jaegerianus*

(Pod laterally compressed)

XXXVIII. Sect. PACHYPODES

144. *A. pachypus*
    a. *pachypus* (2n = 22)
    b. *Jaegeri*

(Pod erect)

XXXIX. Sect. DRUMMONDIANI

145. *A. Drummondii* (2n = 22)

XL. Sect. MALACI

XL (i). Cibarii

146. *A. cibarius* (2n = 22)

(Pod humistrate)

XL (ii). Ensiformes

147. *A. ensiformis*
148. *A. malacoides*

(Pod pendulous)

149. *A. Minthorniae*
    a. *gracilior*
    b. *Minthorniae*
    c. *villosus*

(Pod erect)

XL (iii). VALLARES

150. *A. vallaris*
151. *A. cimae*
  a. *cimae*
  b. *sufflatus*

XL. (iv). MALACI

152. *A. malacus*
153. *A. chamaemeniscus*

(Pod humistrate, in 152 deflexed)

XLI. Sect. PRUNIFORMES

154. *A. accidens*
  a. *Hendersonii*
  b. *accidens*

*****The Arrect *Homalobi*.—Pod mostly erect and subbi- to fully bilocular; stipules mostly free; valves of the pod mostly leathery or woody. Includes *Hamosa* sensu Rydb., p.p., *Hesperonix* Rydb., *Cnemidophacos* Rydb., p.p., *Tium* sensu Rydb., p.p., *Jonesiella* Rydb., *Brachyphragma* Rydb., p.p., *Phaca* subgen. *Dermatocystis* Rydb. (Sects. XLII–LII).

XLII. Sect. REVENTI-ARRECTI

XLII (i). REVENTI-ARRECTI

155. *A. reventus*
156. *A. Sheldoni* (2n = 24)
157. *A. adanus*

XLII (ii). TERMINALES

158. *A. terminalis*

(Vesture dolabriform)

XLII (iii). ARRECTI

159. *A. riparius* (2n = 24)
160. *A. arrectus* (2n = 24)

XLII (vi). EREMITICI

161. *A. atropubescens*
162. *A. remotus*
163. *A. eremiticus* (2n = 24)
164. *A. scaphoides*

XLII (v.) ORCUTTIANI

165. *A. Orcuttianus*

XLII (vi). OBSCURI

166. *A. obscurus*

XLIII. Sect. MICHAUXIANI

167. *A. Michauxii*

XLIV. Sect. NUDI

168. *A. Serenoi*
  a. *Serenoi* (2n = 22)
  b. *sordescens*

XLV. Sect. CONJUNCTI

169. *A. conjunctus* (2n = 24)
170. *A. hoodianus*
171. *A. reventiformis*
172. *A. Leibergi*

XLVI. Sect. HESPERONIX

173. *A. Bolanderi* (2n = 22)

(Stipules connate; pod unilocular except in some *Conjuncti*, *Hesperonix*)

XLVII. Sect. BICRISTATI

XLVII (i). WEBBERANI

174. *A. Webberi*

XLVII (ii). BICRISTATI

175. *A. bicristatus*

XLVIII. Sect. PORRECTI
176. *A. porrectus*

XLIX. Sect. AMPULLARII
177. *A. ampullarius*

L. Sect. PACHYPHYLLUS
178. *A. asclepiadoides* } (Leaflet solitary)

LI. Sect. PREUSSIANI
LI (i). PREUSSIANI
179. *A. Preussii*
a. *Preussii* (2n = 24)
b. *laxiflorus*
180. *A. Eastwoodae*
181. *A. Crotalariae* (2n = 24)
182. *A. mokiacensis*
183. *A. Beathii* (2n = 24) } (Seleniferous)
LI (ii). PATTERSONIANI
184. *A. praelongus*
a. *praelongus* (2n = 24)
b. *Ellisiae*
c. *lonchopus*
185. *A. Pattersoni*
LI (iii). SABULOSI
186. *A. sabulosus* (2n = 26)

LII. Sect. NEGLECTI
187. *A. neglectus* (2n = 22) } (Mesophyte)

C. The Cercidothrix Phalanx (Sects. LIII–LIV)

Vesture dolabriform; calyx not inflated in fruit; n = 8. The equivalent of the Old World subgen. *Cercidothrix* Bge., our 3 spp. characterized by connate stipules and erect, sessile, bilocular pods. Includes *Astragalus* sect. *Uliginosi* sensu Rydb. and sect. *Hypoglottides* Rydb., p.p.

LIII. Sect. ULIGINOSI
188. *A. canadensis*
a. *Mortoni* (2n = 16)
b. *brevidens* } (Flower nodding)
c. *canadensis* (2n = 16)
189. *A. oreganus*

LIV. Sect. ONOBRYCHOIDEI
190. *A. adsurgens*
b. *robustior* (2n = 32) } (Flower erect)
c. *tananaicus* (2n = 32)

D. The Hypoglottis Phalanx (Sect. LV)

Vesture basifixed; flowers erect, crowded into dense heads or spiciform racemes; n = 8, 16, 32.—The equivalent of the Old World subgen. *Hypoglottis* Bge., perhaps only artificially separated from the genuine *Astragali*, most of which have a loosely racemose or subumbellate inflorescence. Ours have connate lower stipules and erect-ascending, persistent, fully bilocular pods. Includes *Astragalus* sect. *Hypoglottides* Rydb., p.p.

LV. Sect. HYPOGLOTTOIDEI
191. *A. agrestis* (2n = 16)
— *A. Cicer* (introduced) has 2n = 64

E. The Piptoloboid Phalanx (Sects. LVI–XC)

Pod sessile, deciduous from the receptacle; n = 11, 12, 13, 14; North and South American.

*The Large-flowered *Piptolobi*.—Calyx-tube deeply campanulate to cylindric; pod uni-, semibi- or bilocular, of leathery, woody or pithy texture (except in sects. LXIII, p.p. and LXIV); stipules nearly always free; North America only. Includes *Xylophacos* Rydb., *Geoprumnon* Rydb., *Pterophacos* Rydb., *Astragalus* sect. *Mollissimi* Rydb., *Phacae* nonnullae sensu Rydb. (Sects. LVI–LXV).

LVI. Sect. ARGOPHYLLI

LVI (i). Argophylli

192. *A. argophyllus*
    a. *argophyllus*
    b. *Martini*
    c. *panguicensis*
193. *A. zionis*
194. *A. marianus*
195. *A. desereticus*
196. *A. callithrix*
197. *A. tephrodes*
    a. *brachylobus*
    b. *tephrodes*
    c. *chloridae*
    d. *eurylobus*
198. *A. iodopetalus*
199. *A. Shortianus*
200. *A. cyaneus*
201. *A. columbianus*
202. *A. Tidestromii*

LVI (ii). Pseudargophylli

203. *A. Waterfallii* } (Pod bilocular)
204. *A. feënsis* }

LVI (iii). Neomexicani

205. *A. neomexicanus* } (Flower nodding)

LVI (iv). Newberryani

206. *A. uncialis*
207. *A. musiniensis*
208. *A. loanus*
209. *A. Newberryi*
    a. *Newberryi*
    b. *Blyae*
210. *A. eurekensis*

LVI (v). Coccinei

211. *A. coccineus*

LVI (vi). Eriocarpi

212. *A. Purshii*
    a. *Purshii* (2n = 22)
    b. *tinctus*
    c. *glareosus* (2n = 22)
    d. *pumilio*
    e. *ophiogenes*
    f. *concinnus*
    g. *lectulus*
    h. *lagopinus*
213. *A. leucolobus* } (Pod bilocular)
214. *A. subvestitus* }
215. *A. funereus*
216. *A. utahensis*
217. *A. nudisiliquus*
218. *A. inflexus* (2n = 22)

LVI (vii). Parryani

219. *A. Parryi* } (Calyx-tube campanulate)

LVI (viii). MISSOURIENSES
220. *A. castaneiformis*
a. *castaneiformis*
b. *consobrinus*
221. *A. Chamaeleuce* (2n = 22)
222. *A. amphioxys*
a. *amphioxys*
b. *modestus*
c. *vespertinus*
223. *A. musimonum*
224. *A. cymboides*
225. *A. missouriensis*
a. *missouriensis* (2n = 22)
b. *amphibolus*
c. *mimetes*
226. *A. accumbens*

(Vesture dolabriform)

(Pod persistent, except var. *amphibolus*)

LVI (ix). ANISI
227. *A. anisus*

(Pod bilocular)

LVII. Sect. DESPERATI

LVII (i). NATURITENSES
228. *A. naturitensis*
229. *A. monumentalis*
230. *A. deterior*

(Septum present)

LVII (ii). DESPERATI
231. *A. desperatus*
a. *desperatus*
b. *conspectus*

(Calyx-tube campanulate, except in 231b)

LVIII. Sect. LAYNEANI
232. *A. Layneae*

LIX. Sect. MOLLISSIMI
LIX (i). MOLLISSIMI
233. *A. mollissimus*
a. *mollissimus*
b. *Coryi*
c. *Earlei* (2n = 22, 24)
d. *nitens*
e. *irolanus*
f. *Bigelovii*
g. *marcidus*
h. *mogollonicus*
i. *Matthewsii*
j. *Thompsonae*

(Pod bilocular)

LIX (ii). ORTHANTHI
234. *A. Helleri*

LX. Sect. GIGANTEI
235. *A. giganteus*

(Flower nodding; pod persistent)

LXI. Sect. SARCOCARPI
LXI (i). SARCOCARPI
236. *A. crassicarpus*
a. *crassicarpus* (2n = 22)
b. *Paysoni*
c. *cavus*
d. *Berlandieri*
e. *trichocalyx*
237. *A. gypsodes* (2n = 24)
238. *A. plattensis*
LXI (ii). SANGUINEI
239. *A. sanguineus*

LXII. Sect. TENNESSEENSES

240. *A. tennesseensis*

LXIII. Sect. MEGACARPI (Flower erect)

241. *A. megacarpus*
242. *A. oophorus* (Pod bladdery, unilocular)
   a. *oophorus*
   b. *Clokeyanus*
   c. *lonchocalyx*
   d. *caulescens* (Flower nodding)
243. *A. Beckwithii*
   a. *Beckwithii* (Pod leathery, semibilocular)
   b. *purpureus*
   c. *weiserensis* (2n = 22)
   d. *sulcatus*

LXIV. Sect. LUTOSI (Pod bladdery, unilocular)

244. *A. lutosus*

LXV. Sect. PTEROCARPI (Pod leathery, unilocular)

245. *A. Casei* (2n = 22)
246. *A. pterocarpus* (2n = 22)
247. *A. tetrapterus* (2n = 22)

**The Pacific *Piptolobi*.—A heterogeneous group of cismontane, mostly coastal and insular dispersal in California and northern Baja California, combining features of genuine *Homalobi*, Large-flowered *Piptolobi*, and Small-flowered *Piptolobi*, possibly representing recombination types derived from crossing of these lines of inheritance; stipules connate in Sects. LXVI, LXVII (except *A. pomonensis*), free in Sect. LXVIII (except *A. asymmetricus*); *pod* sessile and deciduous in Sects. LXVI, LXVII (elevated on a gynophore in 253, 255), stipitate and persistent in Sect. LXVIII, the body papery, inflated, unilocular. Includes *Phaca* sects. *Oxyphysae, Trichopodae, Densifoliae* and *Candidissimae* Rydb., and *Homalobus* sect. *Stenophylli* Rydb., p.p. (Sects. LXVI–LXVIII).

LXVI. Sect. ANEMOPHILI

248. *A. anemophilus*
249. *A. miguelensis*
250. *A. Harbisonii*

LXVII. Sect. DENSIFOLII

LXVII (i). Densifolii

251. *A. Nuttallii* (Pod sessile, deciduous)
   a. *Nuttallii*
   b. *virgatus*
252. *A. pomonensis* (2n = 22) (Stipules connate, except in 252)
253. *A. curtipes*

LXVII (ii). Pycnostachyi

254. *A. pycnostachyus*
   a. *pycnostachyus*
   b. *lanosissimus*

LXVII (iii). Oxyphysi

255. *A. oxyphysus*

LXVIII. Sect. TRICHOPODI

256. *A. asymmetricus* (Pod stipitate, persistent)
257. *A. trichopodus*
   a. *lonchus* (2n = 22)
   b. *trichopodus* (Stipules free)
   c. *phoxus*

***The Small-flowered *Piptolobi*.—Calyx-tube campanulate; pod sessile, deciduous, mostly papery, ± inflated (often bladdery) and unilocular, if bilocular strongly inflated, unilocular if not inflated; stipules nearly always free; mostly North, a few South American.

Includes *Phaca* subgen. *Chartocystis* (excl. sects. *Lutosae, Polares, Jejunae* p.p. and *Microcystes* p.p.) Rydb., *Cystium* sensu Rydb., and *Batidophaca* Rydb., p.p. (Sects. LXIX–LXXVIII).

LXIX. Sect. INFLATI

LXIX (i). Inflati

258. *A. Douglasii*
   a. *Douglasii*
   b. *Parishii*
   c. *perstrictus*
   d. *glaberrimus*
259. *A. macrodon*
260. *A. oocarpus* (2n = 22)
261. *A. Deanei*

LXIX (ii). Proriferi

262. *A. gruinus*
263. *A. Palmeri*
264. *A. prorifer*
265. *A. idrietorum*
266. *A. piscinus*
267. *A. fastidius*
268. *A. magdalenae*
   a. *magdalenae*
   b. *niveus*
   c. *Peirsonii*

LXIX (iii). Aridi

269. *A. allochrous* (2n = 22)
270. *A. Wootoni*
   a. *Wootoni* (2n = 22)
   b. *Candollianus*
271. *A. Thurberi*
272. *A. Wardi*
273. *A. aquilonius*
274. *A. cerussatus*
275. *A. endopterus*
276. *A. serpens*
277. *A. pubentissimus*
278. *A. pardalinus*
279. *A. sabulonum*
280. *A. nutans*
281. *A. Gilmani*
282. *A. insularis*
   a. *insularis*
   b. *quentinus*
   c. *Harwoodii*
283. *A. Geyeri*
   a. *Geyeri*
   b. *triquetrus*
284. *A. aridus*

LXIX (iv). Sparsiflori

285. *A. Wetherilli*
286. *A. sparsiflorus*
   a. *majusculus*
   b. *sparsiflorus*
287. *A. diaphanus* (2n = 28)

LXIX (v). Horniani

288. *A. Hornii*
   a. *Hornii*
   b. *minutiflorus*

LXX. Sect. DIPHYSI

289. *A. lentiginosus*
   a. *lentiginosus* (2n = 22)

b. *scorpionis*
c. *salinus*
d. *floribundus*
e. *macrolobus*
f. *ineptus*
g. *semotus*
h. *sierrae*
i. *antonius*
j. *albifolius*
k. *sesquimetralis*
l. *kernensis*
m. *platyphyllidius*
n. *toyabensis*
o. *latus*
p. *idriensis*
q. *oropedii*
r. *chartaceus*
s. *araneosus*
t. *diphysus*
u. *australis*
v. *yuccanus*
w. *stramineus*
x. *vitreus*
y. *ambiguus*
z. *Fremontii*
za. *Kennedyi*
zb. *variabilis* (2n = 22)
zc. *nigricalycis*
zd. *coachellae*
ze. *micans*
zf. *borreganus*
zg. *maricopae*
zh. *palans* (2n = 22)
zi. *ursinus*
zj. *Wilsonii*

290. *A. iodanthus*
a. *iodanthus*
b. *vipereus*

291. *A. pseudiodanthus*

(Pod little inflated although septum present)

(Pod little inflated, septum often absent)

LXXI. Sect. MONOENSES

292. *A. monoensis*
293. *A. Ravenii* (2n = 22)
294. *A. Pulsiferae*
a. *Suksdorfii*
b. *Pulsiferae* (2n = 24)
295. *A. Perianus*

LXXII. Sect. CYSTIELLA

296. *A. striatiflorus*

LXXIII. Sect. CIRCUMDATI

297. *A. circumdatus*

LXXIV. Sect. PLATYTROPIDES

298. *A. platytropis*
299. *A. amnis-amissi*
300. *A. amblytropis*

(Stipules connate; septum present except in 294–5)

(Pod leathery, not inflated, semibilocular)

LXXV. Sect. VILLOSI

LXXV. (i). AUSTRO-ORIENTALES

301. *A. distortus*
a. *distortus*

b. *Engelmanni* (2n = 26)
302. *A. Soxmaniorum*
303. *A. obcordatus*
LXXV (ii). VILLOSI
304. *A. villosus*
(Pod ± trigonous, not inflated, but unilocular)

LXXVI. Sect. LOTIFLORI
305. *A. lotiflorus* (2n = 26)
(Vesture dolabriform)

LXXVII. Sect. PANAMINTENSES
306. *A. panamintensis*
(Pod declined, semibilocular)

LXXVIII. Sect. HUMILLIMI
LXXVIII (i). TROGLODYTI
307. *A. troglodytus*
LXXVIII (ii). HUMILLIMI
308. *A. gilensis*
309. *A. siliceus*
310. *A. cremnophylax*
311. A. *humillimus*
(Vesture dolabriform)
(Acaulescent; pod very small, leathery, unilocular)

****The Hamosoid *Piptolobi*.—As the preceding, but the pod very rarely inflated (*A. diphacus*), always bilocular (cf. *A. Nuttallianus* vars.), usually trigonous and grooved dorsally, sometimes peltate, or didymous; North American. Includes *Hamosa* sensu Rydb. p. max. parte (excl. sect. *Malacae, Wrightianae,* and *Tricarinatae* p.p.), *Astragalus* sects. *Chaetodontes, Lentiformes,* and *Breweriani* Rydb., *Brachyphragma* sect. *Brauntoniana* Rydb., and *Hesperastragalus* A. Hell. sens. lat. (Sects. LXXIX–XC).

LXXIX. Sect. LEPTOCARPI
LXXIX (i). PRINGLEANI
312. *A. nothoxys*
313. *A. Pringlei*
314. *A. Bryantii*
315. *A. Gentryi*
LXXIX (ii). ARIZONICI
316. *A. arizonicus*
(Vesture dolabriform)
LXXIX (iii). MOHAVENSES
317. *A. albens*
318. *A. mohavensis*
a. *hemigyrus*
b. *mohavensis*
LXXIX (iv). PARVI
319. *A. parvus*
320. *A. hypoxylus*
LXXIX (v). TRICARINATI
321. *A. tricarinatus*
322. *A. bernardinus*
LXXIX (vi). CALIFORNICI
323. *A. Emoryanus*
a. *Emoryanus*
b. *terlinguensis* (2n = 24)
324. *A. nyensis*
325. *A. acutirostris*
326. *A. francisquitensis*
327. *A. tener*
a. *tener*
b. *Titi*
328. *A. pauperculus*
329. *A. Rattani*
a. *Rattani*
b. *Jepsonianus*
330. *A. Clarianus*
331. *A. Breweri*

LXXIX (vii). COAHUILANI
332. *A. coahuilae*
LXXIX (viii). LEPTOCARPI
333. *A. Nuttallianus*
a. *Nuttallianus* (2n = 22)
b. *micranthiformis*
c. *macilentus*
d. *pleianthus*
e. *trichocarpus*
f. *austrinus*
g. *imperfectus*
h. *cedrosensis*
i. *zapatanus*
334. *A. leptocarpus* (n = 13)
335. *A. Lindheimeri*

(Pod persistent)

LXXX. Sect. SUCCUMBENTES
336. *A. succumbens*

LXXXI. Sect. SCAPOSI
337. *A. calycosus*
a. *calycosus*
b. *monophyllidius*
c. *mancus*
d. *scaposus*

(Flower elongate)

(Acaulescent; vesture dolabriform)

LXXXII. Sect. GREGGIANI
338. *A. Greggii*

LXXXIII. Sect. MICRANTHI
339. *A. Hartwegi*
340. *A. vaccarum*
341. *A. Goldmani*
342. *A. Clevelandi*
343. *A. oxyrrhynchus*

(Flowers tiny, deflexed like the pod)

LXXXIV. Sect. HYPOLEUCI
344. *A. hypoleucus* (2n = 28)

(Stipules connate; vesture dolabriform)

LXXXV. Sect. CHAETODONTES
LXXXV (i). CHAETODONTES
345. *A. Spaldingii* (2n = 24)
346. *A. tyghensis*

(Calyx inflated)

LXXXV (ii). LYALLIANI
347. *A. Lyalli*

(Stipules free)

LXXXV (iii). LEMMONIANI
348. *A. Lemmoni*

(Mesophyte)

LXXXV (iv). LENTIFORMES
349. *A. caricinus*
350. *A. lentiformis*
LXXXV (v). ANDERSONIANI
351. *A. Andersonii* (2n = 24)
352. *A. sepultipes*
353. *A. Austinae*

(Stipules connate)

LXXXVI. Sect. BRAUNTONIANI
A. Brauntonii

LXXXVII. Sect. DIPHACI
355. *A. diphacus*

(Pod didymous)

LXXXVIII. Sect. REFLEXI
356. *A. reflexus*

LXXXIX. Sect. SCUTANEI (Pod peltiform)
357. *A. scutaneus*
358. *A. brazoensis* (2n = 22)

XC. Sect. MICROLOBIUM (Annuals)
XC (i). GAMBELIANI
359. *A. Gambelianus*
XC (ii). MICROLOBIUM
360. *A. didymocarpus*
a. *didymocarpus* (n = 12)
b. *Milesianus*
c. *dispermus* (n = 13)
d. *obispensis*

F. The Trimeniaeus Phalanx

A heterogenous group defined in terms of the annual root, all but one gerontogean, probably best referred to Phalanx A; n = 8 (?) in the Old World, reportedly 11 with us. The equivalent of *Astragalus* sect. *Wrightiani* Rydb. (Sect. XCI).

XCI. Sect. SESAMEI
361. *A. Wrightii* (2n = 22)

G. The Orophaca Phalanx

A small, peculiar group of North American species, characterized by dolabriform vesture, 3-foliolate leaves, large, hyaline, connate-sheating stipules, and small, unilocular pods. The first section suggests some *Homalobi*, the second some Large-flowered *Piptolobi* and (probably only superficially) some species of the Asiatic sect. *Trachycercis* Bge. The equivalent of the genus *Orophaca* Nutt. (Sects. XCII–XCIII).

XCII. Sect. SERICOLEUCI (Calyx-tube campanulate; banner obovate)
362. *A. sericoleucus*
363. *A. aretioides*
364. *A. tridactylicus*
365. *A. Barrii*

XCIII. Sect. OROPHACA (Calyx-tube cylindric; banner oblanceolate)
366. *A. gilviflorus* (2n = 24)
367. *A. proimanthus*
368. *A. hyalinus*

The chromosome numbers listed in the foregoing synopsis are derived from the following authors, listed in the general bibliography: Head, 1957; Holmen, 1962; James, 1951; Ledingham, 1957, 1960; Snow, 1959; Vilkomerson, 1943. A fuller bibliography of cytological references to *Astragalus* is given by Ledingham, 11. cc.

SYSTEMATIC TREATMENT

ASTRAGALUS

Caulescent therophytes, caulescent and acaulescent chamaephytes and hemicryptophytes, and suffruticose or low fruticose (often spiny) phanerophytes (in North America seldom more than suffruticulose at base), with a taproot and (after the first season) an aerial, cespitose, or subterranean caudex (sometimes stoloniform and adventitiously rooting), ± pubescent (the inflorescence especially) with

unicellular, basifixed or dolabriform hairs, exceptionally almost glabrous; *stipules* either cauline, or cauline and adnate to the petiole, or amplexicaul and connate into a contrapetiolar sheath; *leaves* alternate, commonly imparipinnate, the terminal leaflet sometimes wanting or reduced to a spine or a filiform appendage (but never a tendril), the lateral (or all) leaflets either petiolulate, or sessile, or more rarely decurrent into the ventrally grooved rachis, the leaflets in rare cases palmately 3–5-foliolate, or 1 and terminal, or (in some or all leaves) lacking and the leaf then reduced to the filiform rachis or a dilated phyllode, the rachis in ours seldom indurated and never (as often in the Old World) truly spiny; *inflorescence* axillary, sometimes appearing radical, pedunculate or sessile, the papilionaceous flowers racemose, subumbellate, or spicate, variously oriented at anthesis; *bracts* 1–2 (1 in North American species); *bracteoles* 0–2, attached at base of the calyx or on the pedicel; *calyx* campanulate or cylindric, obscurely 2-lipped, 5-toothed, ± thickened at base into a feebly nectariferous disc, either ruptured by the expanding fruit or marcescent unruptured about its base, sometimes (with us rarely) inflated in age and enveloping the fruit, rarely circumscissile above the disc; *petals* inserted on the disc, the banner always free, the claws of wings and keel either free (with us always so) or adnate to the staminal tube, all either deciduous or marcescent, glabrous or dorsally pubescent; *banner* recurved through 20–180° from the vertical, variable in outline, mostly emarginate at apex; *wings* commonly shorter than the banner and longer than the keel, clawed, the blade auriculate at base, the inner face bearing a pit shortly above the auricle; *keel* commonly shortest, the claws free from each other, the blades ± united by their exterior margins, obtuse (or exceptionally acute or even acutely appendaged), each bearing externally above the short basal auricle a protuberance fitting into (but not physically adherent to) the corresponding pit on the wing; *stamens* diadelphous (one monadelphous sp. in Asia), the vexillar one free, the filaments of the rest united for ± ¾ their length; *anthers* eglandular, in 2 sets of 5, those of one set slightly larger; *style* glabrous, rarely pubescent distally; *stigma* minute, subsymmetrically terminal, glabrous or puberulent; *ovary* sessile or stipitate; *pod* exceedingly variable in orientation, size, shape, texture, and mode of compression, either sessile on and disjointing from the receptacle or from a stipelike gynophore, or sessile and persistent, or contracted at base into a stipe and then always persistent (but often deciduous with the disjointing pedicel and marcescent calyx), the body varying from linear to globose (or even broader than long) in dorsiventral view, nearly always asymmetric in profile, straight, or incurved, or more rarely decurved or coiled inward, varying in length from ± 2 mm. to ± 6 cm., and in compression from terete to laterally or dorsiventrally compressed, or trigonus (rarely tetragonous), often grooved along the dorsal (abaxial) side and carinate by the ± prominent ventral (adaxial) suture, the valves varying from thinly membranous (subdiaphanous) to thickly fleshy or pulpy turning woody on ripening, commonly reticulate externally (rarely smooth, or marginally winged, or transversely wrinkled, or otherwise roughened or appendaged), the cavity either filled with seeds (and also with pulpy filaments) or larger than the seeds (the pod then either tumescent or inflated, often bladdery), unilocular or sembilocular to fully bilocular by means of a recessive fold or thin double membrane (septum) formed by intrusion of the endocarp from the abaxial toward the adaxial suture; *ovules* 2-seriate, 2-many, borne on slender funicles sometimes united at base by a membrane or funicular flange simulating the septum (but issuing from the ventral suture); *seeds* compressed, either circular, or oblong, or mitten-shaped, or prismatic in lateral view, notched at the hilum.—A vast genus, rivaled for size only by *Carex, Solanum,* and *Senecio,* its numbers variously estimated at 1200, 1600, and 2000 spp. (the total depending largely on the censor's taxonomic viewpoint), most

highly developed in arid continental, desert, and Mediterranean climates, circumboreal (except Greenland, where 1 sp. is sparingly introduced) in dispersal, most numerous in central Asia, Iran and Turkey, in western North America, and in the Andes of South America, extending south in the Old World to equatorial Africa and subtropical India, in North America to Honduras, and in South America to Patagonia, about 370 North American, 100 South American, the remainder gerontogean.

ASTRAGALUS L., Sp. Pl. 755. 1753 & Gen. Pl., Ed. 5, 335. 1754.—Generitypus (cf. sub. sect. *Astragalo,* p. 100), *A. alpinus* L.

KEYS

NOTE ON THE KEYS

Because of the superficially heterogeneous nature of some of the larger sections and the innate variability of many of the species, it is not possible to prepare a key to all North American *Astragali,* even at the level of section, which is at once compact and workable. The best that I have been able to construct requires 500 odd dichotomies, and is an extremely cumbrous device. I have therefore replaced it with a set of regional keys. Owing to the high incidence of local endemism in the genus, the astragaline floras of several large floristic provinces are substantially different and can thus be treated advantageously without too much repetition. While the advantages of an overall key have been sacrificed, the reader seeking to determine an Alaskan or Californian *Astragalus* is not required to make a circuitous and laborious approach through thickets of Cordilleran and Mexican species.

For the purpose I have divided the Continent into eleven provinces, defined below. It will be apparent at once that provinces defined by political divisions are precise but unnatural, whereas those defined by climatic or geographic barriers may be natural but are regrettably imprecise. Species known to occur along or near the nebulous periphery of the natural provinces, indicated by wavy lines on the accompanying map, have been keyed as though native to both provinces. The probability that species will be found to extend into provinces where they are not known to date should not be overlooked.

Contrary to what has been written, ripe fruit is by no means always necessary for the determination of *Astragalus* species, although it is always useful and may be required in some nearly related pairs or critical groups. The ensuing regional keys employ, so far as practical, vegetative characters visible from early anthesis onward. These features will carry the inquirer at least to the neighborhood of his goal, from which point he can pursue the quarry through the sectional keys dispersed through the Atlas.

Regional Key I (p. 57).—Alaska; all of Canada except for the Fraser and upper Columbia Valleys in British Columbia; New England (Vermont, New Hampshire, Maine, Massachusetts, Rhode Island, Connecticut).

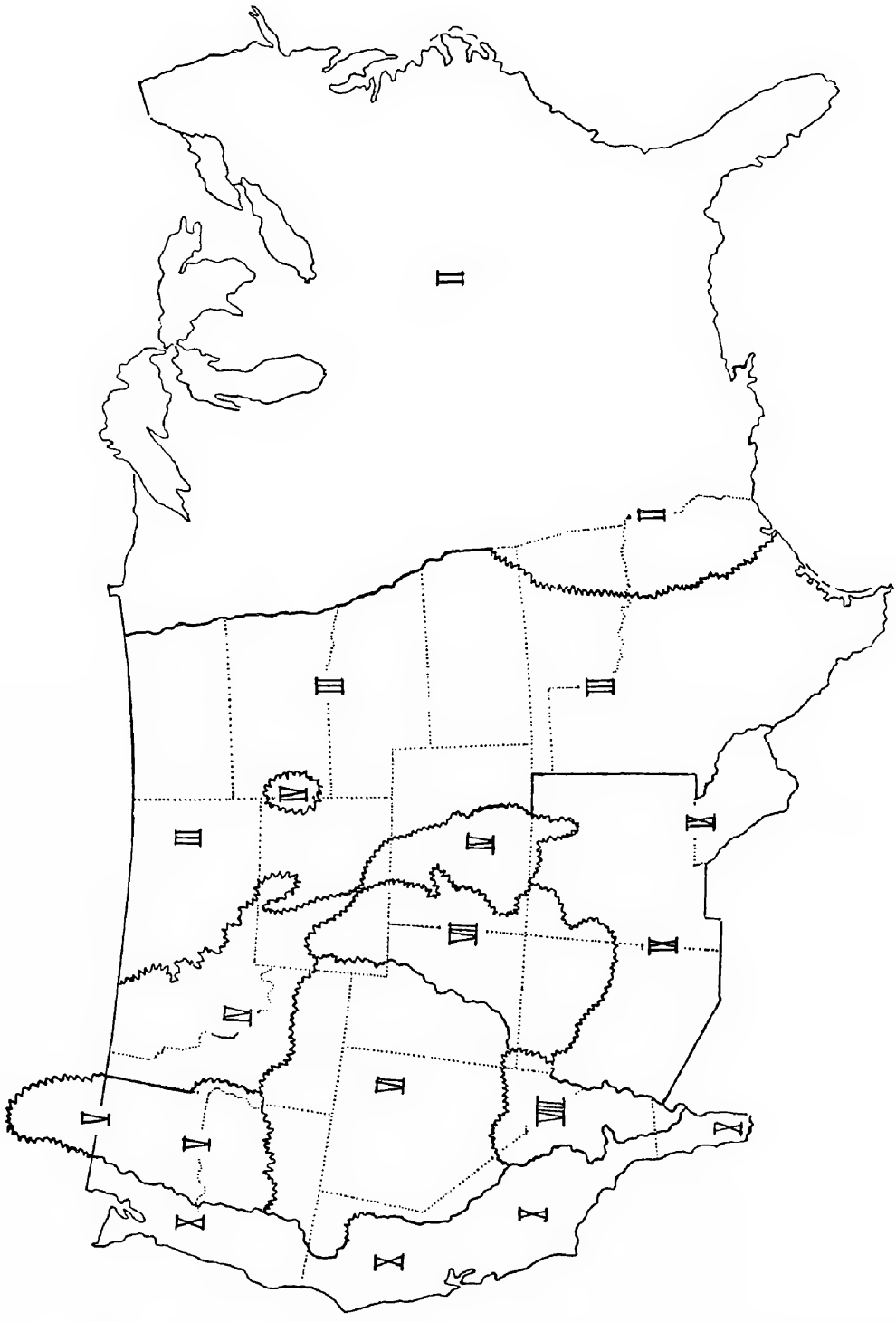
Regional Key II (p. 59).—Eastern and southeastern United States from New York to Minnesota, s. to the Ozark Plateau, e. Texas, and Florida. The w. line follows the boundary of Minnesota, Iowa, and Missouri s. to 38° N., thence cuts obliquely s.-w. and s. to include the s.-e. corner of Kansas, e. Oklahoma, and e. Texas, reaching the Gulf at Galveston Bay.

Regional Key III (p. 61).—Prairie States. This region is bounded to the e. by the preceding and to the w. by the Rocky Mountain foothills in Montana, Wyoming, and Colorado, the New Mexico State line, and the Pecos River in Texas. The enclave of the Black Hills, South Dakota and adjoining Wyoming, is included in the next.

Regional Key IV (p. 63).—Rocky Mountains, Idaho n. and e. of the Snake River Valley; w. Montana; the Yellowstone region and the Big Horn and Wind River Ranges in Wyoming; the Colorado Rocky Mountains with their natural extensions into s.-centr. Wyoming and n. New Mexico. This region is bounded e.-ward by the prairies and w. in Colorado by the upper line of the piñon-juniper association.

Regional Key V (p. 68).—Columbia Basin. Washington e. of the Cascade crest; interior s. British Columbia; Oregon e. of the Cascades and n. of the Great Basin drainage; Grand Canyon of the Snake River in w.-centr. Idaho (downstream from Weiser).

Regional Key VI (p. 71).—Great Basin. The parts of intermountain United States without drainage to either ocean. It includes all of Nevada except the *Larrea* deserts of the s. corner, Utah w. of the Wasatch crest and n. of the Virgin River Valley, s.-w. Wyoming w. of the Green River drainage, the Snake River Valley in Idaho downstream as far as Weiser, Oregon s. of the Blue Mountains and e. of the Cascades, and California e. of the Cascade and Sierra crests (thus including a segment draining to the Pacific) s. to n. Inyo County.



The United States, shorn of New England, but with parts of southern British Columbia and northern Baja California added, showing the areas covered by Regional Keys II–X. New England with the rest of Canada and Alaska are covered by Key I; the rest of Mexico south to Panama by Key XI.

Regional Key VII (p. 77).—Colorado Basin. The plateau drained by the Green, Grand, Little Colorado, and Colorado Rivers, downstream to the Grand Canyon and including the upper Virginia Valley in Utah. The n. and e. boundaries correspond approximately with the edge of the juniper-piñon forest, the s. boundary with the lower edge of the Mogollon pine forest (or in n.-w. New Mexico by the Continental Divide), the w. boundary in Utah with the Wasatch crest. The Uinta Mountains are included.

Regional Key VIII (p. 82).—Mohave and Colorado Deserts. Transmontane California s. from n. Inyo County, s. Nevada, extreme s.-w. Utah and n.-w. Arizona, and n.-e. corner of Baja California. The n. limit is coextensive with *Yucca arborescens*.

Regional Key IX. (p. 84).—Arizona, New Mexico, and western Texas. Includes all of New Mexico except the n.-w. corner draining to the Colorado and the Rocky Mountains n.-ward from Santa Fe; Texas w. of the Pecos River; and Arizona s. from and including the Mogollon pine forests. The limits of regions VII, VIII & IX in n.-w. Arizona are nebulous.

Regional Key X (p. 87).—Pacific Coast. All of Oregon, Washington, and California lying w. of the Cascade and Sierra crests and the inner South Coast Ranges; Baja California except the Colorado Delta region in the extreme n.-e. corner. Includes in s. California the pine belt upward in the transverse (San Gabriel and San Bernardino) and desert-bordering (Santa Rosa, Cuyamaca) mountains.

Regional Key XI. (p. 89).—Mexico and Central America. Mexico except Baja California to Panama.

Regional Key I. Alaska, Canada (except parts of s. British Columbia), and New England (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut)

1. Stipules at the lower, leafless nodes united on the side corresponding with the suppressed petiole into an entire, obtuse blade; *plants* stoloniferous, perennial, with few (7–15) ample, penninerved leaflets, nodding flowers, and pendulous, stipitate, inflated, unilocular pods of papery texture; *ovules* 6–10 ..... Sect. *Phaca* (p. 91)
1. Stipules at the lower nodes free or connate, but if united then connate opposite the petiole, or adnate to the suppressed petiole, the sheath so formed emarginate or bidentate; other characters different (2)
   2. Leaflets 3–7, linear-elliptic, continuous with the rachis and mucronate or spinulose at apex, commonly becoming stiff and prickly in age; low tufted or matted plants with 1–3-flowered racemes of tiny flowers subsessile in the leaf-axils, connate stipules, and small, compressed, 2–4-ovulate, unilocular pods ..... *A. Kentrophyta* (p. 357)
   2. Leaflets either more numerous, or jointed to the rachis, commonly both, never spinulose or prickly in age (3)
      3. Pubescence composed entirely of basifixed hairs (4)
         4. Stipules all free, or if the lowest ones shortly connate at base then united thus for a space shorter or no longer than the union to the suppressed petiole on the stem's opposite side (5)
            5. Plants caulescent; *pod* not woolly (6)
               6. Flower large, the banner 16.5–26 mm. long; *pod* bilocular; xerophytic plants of the prairies (7)
                  7. Stems decumbent; *leaves* and stems strigulose-pilosulous; *pod* humistrate, sessile, globose or plumply ovoid, fleshy becoming pithy ..... *A. crassicarpus* (p. 753)
                  7. Stems erect; *leaves* and stems villous-hirsute; *pod* pendulous, stipitate, the body linear-oblong in profile ..... *A. Drummondii* (p. 490)
               6. Flower smaller, the banner mostly not over 12 mm., or if up to 16 mm. long the plants arctic or boreal, or mesophytic (8)
                  8. Stems not over 4 dm. long; *pod* either stipitate and pendulous, or if erect and sessile then bilocular and deciduous (9)
                     9. Pod erect, sessile, deciduous, fully bilocular, somewhat inflated; Yukon and adjoining Alaska ..... *A. Williamsii* (p. 144)
                     9. Pod pendulous, stipitate, continuous with the receptacle, subunilocular, the septum very narrow and incomplete; widespread (10)
                        10. Wing-petals obtuse or shallowly emarginate at apex; *leaflets* mostly of a broad type ..... Sect. *Oroboidei* (p. 115)
                        10. Wing-petals bidentate at apex; *leaflets* mostly linear or narrowly elliptic ..... Sect. *Hemiphragmium* (p. 133)
                  8. Stems 5–9 dm. long; *pod* erect, sessile, inflated but rather firm, uni- or

subunilocular, persistent; Great Lakes region ..... *A. neglectus* (p. 593)

5. Plants subacaulescent, tufted, with softly cottony-villous herbage and subradical peduncles; *pod* (sessile, unilocular) very densely white-woolly and -hirsute ..... *A. Purshii* (p. 671)

4. Stipules all, or at least those at the first 2–3 nodes, connate opposite the petiole into a sheath (11)

11. Leaflets long and very narrow, continuous with the rachis. Flowers large, whitish; *pod* deflexed, sessile, fleshy becoming subligneous, unilocular, bicarinate by stout, salient sutures; prairie xerophytes ..... *A. pectinatus* (p. 424)

11. Leaflets jointed to the rachis, commonly of a broader type (12)

12. Stems and foliage villous-hirsute; *pod* pendulous, stipitate, the body linear-oblong, fully bilocular, glabrous; prairie xerophytes ..... *A. Drummondii* (p. 490)

12. Stems and foliage strigulose or shortly villosulous; *pod* either sessile, or if pendulous and stipitate then uni- or subunilocular, and if with any septum then not glabrous (13)

13. Coarse, ill-scented plants of the prairies, with racemes of 20 or more comparatively large, nodding flowers, the banner 13–19 mm. long; *pod* pendulous, stipitate, unilocular ..... Sect. *Bisulcati* (p. 407)

13. More slender plants with either fewer or smaller flowers, or if the flowers as large then erect (14)

14. Flowers long and narrow (the banner at least 15 mm. long), erect and crowded into ovoid or oblong heads; *pod* erect, shortly stipitate, fully bilocular, densely hirsute ..... *A. agrestis* (p. 618)

14. Flowers smaller, loosely racemose; *pod* either sessile or pendulous, never hirsute (15)

15. Stems arising from a determinate root-crown or caudex at soil-level. Montane and prairie xerophytes with *pods* either laterally compressed, or subglobose, unilocular (16)

16. Pod stipitate ..... Sect. *Ervoidei* (p. 342)

16. Pod sessile (17)

17. Pod oblong to ovate or obovate in profile, either compressed or inflated, 5–12 mm. long ..... Sect. *Ervoidei* (p. 342)

17. Pod narrowly oblanceolate or linear in profile, laterally compressed, 13–25 mm. long ..... *A. miser* (p. 231)

15. Stems arising from buds below ground, either together from a buried root-crown, or singly and few together from slender, rhizome-like caudex-branches (18)

18. Racemes loosely 10–45-flowered; *pod* subterete or inversely boat-shaped, sessile or nearly so, unilocular; *stems* mostly 1.5–6 dm. long; prairie ..... Sect. *Scytocarpi* (p. 199)

18. Racemes fewer-flowered, or if not so then the pod stipitate and triquetrous, or the stem shorter; montane, arctic, and riparian plants of moist or cold soils (19)

19. Pod stipitate, the body triquetrous, grooved dorsally, the valves inflexed as a very narrow partial septum ..... *A. alpinus* (p. 103)

19. Pod sessile or elevated on a stipelike gynophore, not grooved dorsally, truly unilocular (20)

20. Pod sessile, slightly to greatly inflated, not strongly compressed, straight or only very slightly incurved (21)

21. Stems 1–4 dm. long (rarely less); *racemes* loose, the axis of the more vigorous ones well over 1.5 cm. long in fruit; *pod* small, 4.5–7.5 mm. long, 2–10-ovulate, little inflated ..... *A. Bodini* (p. 371)

21. Stems 1 dm. long or less; *racemes* subumbellately 1–6-flowered, the axis less than 1.5 cm. long in fruit; *pod* large, greatly inflated, 15–40 mm. long, 8–17-ovulate ..... *A. polaris* (p. 374)

20. Pod elevated on a stipelike gynophore 5–10 mm. long, the body strongly compressed laterally, incurved through ½ circle or more ..... *A. nutzotinensis* (p. 378)

3. Pubescence of the leaves dolabriform (22)

22. Leaves all, or at least the earliest ones, reduced to a simple, narrowly oblanceolate phyllode, the upper ones often 3–5-foliolate. Acaulescent plants with small, narrowly lanceolate or ovate, laterally compressed, unilocular pods 5–13 mm. long ..... *A. spatulatus* (p. 283)
22. Leaves all 3- or all several-foliolate (23)
23. Plants caulescent; *stipules* all or at least the lowest connate, scarious or becoming so, but never very large or hyaline; *pods* erect, sessile, bilocular (24)
24. Flowers erect; *stems* 0.5–3 dm. long, arising together from a determinate, superficial root-crown or caudex ..... *A. adsurgens* (p. 610)
24. Flowers nodding at full anthesis, ± retrorsely imbricated; *stems* mostly taller, arising from obliquely ascending or creeping rhizomes ..... *A. canadensis* (p. 598)
23. Plants acaulescent, or low and tufted, the stipules either free or, if connate, then very large and hyaline (25)
25. Leaves pinnate; *stipules* free; *flowers* either pedunculate or, if sessile in the subradical leaf-axils then small, with campanulate calyx-tube; *ovules* 30 or more (26)
26. Calyx-tube shallowly campanulate, 2–4.5 mm. long; *banner* (with us) scarcely over 1 cm. long ..... *A. lotiflorus* (p. 994)
26. Calyx-tube deeply campanulate to cylindric, 6–9 mm. long; *banner* mostly 16–22 mm. long ..... *A. missouriensis* (p. 711)
25. Leaves 3-foliolate; *flowers* solitary and paired, sessile or nearly so among the tufted leaves, long and narrow, the calyx-tube cylindric; *stipules* very large, hyaline, connate; *ovules* 10–17 ..... *A. gilviflorus* (p. 1151)

Regional Key II. Eastern United States (excluding New England) to Florida, w. to Minnesota, the Ozark Plateau, and c. Texas

1. Plants perennial (2)
2. Pubescence basifixed (3)
3. Stems, leaves and sessile pods hirsute with widely spreading hairs up to 1 mm. long or more (4)
4. Flower small, the calyx-tube campanulate, the banner ± 9–11 mm. long; *pod* of thin texture, subunilocular; plants of the Atlantic and Gulf Coastal Plains ..... *A. villosus* (p. 992)
4. Flower large, the calyx-tube subcylindric, the banner 14–19 mm. long; *pod* thickly fleshy becoming alveolate externally when ripe; plants of the interior, Illinois to n. Alabama ..... *A. tennesseensis* (p. 769)
3. Stems and leaves strigulose or pilosulous with shorter, appressed or narrowly ascending hairs; *pod* strigulose or glabrous (or if hirsute then stipitate) (5)
5. Stipules all free (6)
6. Plants of the Great Lakes region, tall mesophytes (the stems mostly over 5 dm. long), with white flowers and erect, sessile, inflated, uni- or subunilocular pods ..... *A. neglectus* (p. 593)
6 Plants from further s., but if entering the Great Lakes region the stems shorter, the pod not inflated, and the flowers commonly purple (7)
7. Stems few or solitary, tall (4.5–9 dm.); *flower* large, the banner 14–19 mm. long; *calyx-tube* campanulate, the sinuses between the teeth silky-ciliate; *pod* incurved-ascending, persistent, narrowly oblong-oblanceolate in profile, semibilocular; North Carolina to Florida ..... *A. Michauxii* (p. 542)
7. Stems several or many, much shorter in the range of the preceding; *flower* large or small, but if as large then the calyx-tube subcylindric and the range western (8)
8. Flower large, the subcylindric calyx-tube 5.5–9.5 mm. long; *banner* at least 16 mm. long; *pod* large, broadly ovoid, obovoid, or subglobose, the fleshy valves pithy in age, the body at least 1 cm. in diameter ..... Sect. *Sarcocarpi* (p. 752)
8. Flower smaller, the campanulate calyx-tube less than 5 mm. long; *banner* less than 15.5 mm. long; *pod* thinly fleshy, drying papery, obliquely ovoid to narrowly ellipsoid, less than 1 cm. in diameter ..... Sect. *Villosi* (p. 984)
5. Stipules at least at the lowest nodes connate (9)

9. Flower large, the banner at least 15 mm. long; *pod* fully bilocular (10)
10. Pod erect, shortly stipitate, triquetrous, grooved dorsally, 7–10 mm. long, hirsute; *inflorescence* more densely and loosely pubescent than the leaves; *ovules* 14–26 ..... *A. agrestis* (p. 618)
10. Pod humistrate, sessile, plumply ovoid or subglobose, 10–17 mm. long, at least 10 mm. in diameter, shallowly grooved along both sutures, strigulose-pilosulous, the valves thickly fleshy; *inflorescence* and foliage equally pubescent; *ovules* 28–48 ..... *A. plattensis* (p. 765)
9. Flower smaller; *pod* uni- or subunilocular (11)
11. Stems arising together from a superficial root-crown or caudex; *stipules* and pendulous, stipitate, laterally flattened, glabrous pods blackening on drying ..... *A. tenellus* (p. 344)
11. Stems arising singly or few together from slender, subterranean, rhizome-like caudex-branches; *stipules* and pod not blackening, the latter either sessile (when subterete or inversely boat-shaped) or both pendulous and stipitate (but then triquetrous), in both cases pubescent (12)
12. Keel slightly longer and about twice as broad as the narrow wings; *pod* pendulous, stipitate, the body triquetrous, grooved dorsally, loosely black-hairy, subunilocular; local on lake shores in Wisconsin ..... *A. alpinus* (p. 103)
12. Keel shorter than the wings; *pod* deflexed, pendulous, or spreading, sessile or nearly so, either elongate and subterete or small and inversely boat-shaped, truly unilocular, white-strigulose; prairie xerophytes ..... Sect. *Scytocarpi* (p. 199)

2. Pubescence of the leaves dolabriform (13)
13. Tall, caulescent plants; *stipules* connate (14)
14. Flowers erect; *stems* 0.5–3 dm. long, arising together from a determinate, superficial root-crown or caudex; *pod* triquetrous, densely strigulose ..... *A. adsurgens* (p. 610)
14. Flowers nodding at full anthesis; *stems* mostly taller, arising from obliquely ascending or creeping rhizomes; *pod* (with us) terete, commonly glabrous (at most only thinly strigulose) ..... *A. canadensis* (p. 598)
13. Low, subacaulescent or shortly caulescent, tufted plants, the stems usually shorter than the longest leaves or inflorescences; *stipules* free (15)
15. Calyx-tube campanulate, 2–4.5 mm. long; *pod* obliquely ovate in profile; *banner* 8.5–14 mm. long ..... *A. lotiflorus* (p. 994)
15. Calyx-tube deeply campanulate to cylindric, 6–9 mm. long; *pod* subsymmetrically oblong in profile; *banner* mostly 16–20 mm. long ..... *A. missouriensis* (p. 711)

1. Plants annual (16)
16. Of the Atlantic and Gulf Coastal Plains from Alabama e.-ward; cf. precociously flowering plants of ..... *A. villosus* (p. 992)
16. Of more western range (w. Louisiana, Arkansas, Oklahoma, Texas) (17)
17. Leaves thinly long-hirsute beneath, glabrous above; *petals* irregularly graduated, the lunately lance-attenuate keel-blades surpassing the narrow, white wings, nearly as long as the purple banner; *pod* small (6–9 mm. long), deflexed, ovoid-triquetrous ..... *A. reflexus* (p. 1125)
17. Leaves glabrous or strigulose beneath, or gray-pilose on both sides; *petals* regularly (sometimes little) graduated; *pod* either longer, or raised on a stipelike gynophore (18)
18. Pod raised on a stipelike gynophore, the body peltiform, very strongly obcompressed, almost round in dorsiventral view; *ovules* 4 ..... *A. brazoensis* (p. 1129)
18. Pod sessile or truly stipitate, the body oblong or linear-oblong in profile, ± triquetrous and grooved dorsally; *ovules* 5 or more (19)
19. Leaves and pods pilose with hairs minutely thickened at base; *flowers* and straight pods (7–13 mm. long) erect, capitate, the flowers very small, the banner ± 5–6 mm. long; *ovules* 5–9 ..... *A. Wrightii* (p. 1140)
19. Leaves and pods glabrous, strigulose or pilosulous, the hairs all filiform; *flowers* spreading, either capitate or loosely racemose, commonly a little larger, the pods usually not erect, or if so longer, and glabrous to loosely strigulose (not pilose); *ovules* mostly 10 or more ..... Sect. *Leptocarpi* (p. 1008)

Regional Key III. Prairies and plains of the United States (Montana e. of the Rocky Mountains and the Dakotas s. to the Oklahoma and Texas Panhandles, w. in Wyoming to the Big Horn Mountains and Platte River Valley and in Colorado to the base of the Rocky Mountains)

1. Stipules at the lower, leafless nodes united on the side corresponding with the suppressed petiole into an entire, obtuse blade; *plants* stoloniferous, perennial, with few (7–15) ample, penninerved leaflets, nodding flowers, and pendulous, stipitate, inflated, unilocular pods of papery texture ..... *A. americanus* (p. 98)
1. Stipules at the lower nodes either free or connate, but if united then connate opposite the petiole, or adnate to the suppressed petiole, the sheath so formed emarginate or bidentate; other characters different (2)
2. Leaflets 3–7, linear-elliptic, continuous with the rachis and mucronate or spinulose at apex, commonly becoming stiff and prickly in age. Low tufted or matted plants with 1–3-flowered racemes of tiny flowers subsessile in the leaf-axils, connate stipules, and small, compressed, 2–4-ovulate, unilocular pods ..... *A. Kentrophyta* (p. 357)
2. Leaflets either more numerous, or jointed to the rachis, commonly both, never spinulose or prickly (3)
3. Annuals, with developed stems and basifixed vesture (4)
4. Pod very obliquely or lunately half-ovate in profile, bladdery-inflated, unilocular; Wyoming ..... *A. Geyeri* (p. 893)
4. Pod linear-oblong in profile, trigonous, bilocular; entering s.-e. Colorado from the s. ..... *A. Nuttallianus* (p. 1059)
3. Perennials (if some forms of *A. lotiflorus* appear annual or actually perish after flowering, then the pubescence dolabriform and the stems very short) (5)
5. Leaves all, or at least the upper ones, reduced to a naked, linear-filiform rachis; *pod* pendulous, shortly stipitate, the body bladdery-inflated, mottled, unilocular ..... *A. ceramicus* (p. 338)
5. Leaves all pinnate (or all trifoliolate), or if some reduced to a leafless rachis this enlarged to an oblanceolate phyllode and the plants acaulescent; *pod* otherwise (6)
6. Pubescence of the leaves dolabriform (7)
7. Stipules all very large, hyaline, connate into imbricated or (distally) shortly discrete sheaths; *leaves* all trifoliolate; acaulescent and tufted or pulvinate, or shortly caulescent and tufted or matted plants (8)
8. Flower long and narrow, the cylindric calyx-tube 6–16 mm. long, the nearly erect, narrowly oblanceolate or narrowly panduriform banner 12.5–28 mm. long (if the banner less than 16 mm. long then pubescent dorsally); *flowers* 1–2, sessile or nearly so in the axils of leaf-rosettes ..... Sect. *Orophaca* (p. 1150)
8. Flower mostly shorter and broader, the campanulate or deeply campanulate tube 2.8–5 mm. long, the more strongly recurved, obovate-cuneate or broadly oblanceolate banner 6.5–16.5 mm. long (always glabrous), and if the banner over 11.5 mm. long, the racemes at least shortly pedunculate ..... Sect. *Sericoleuci* (p. 1143)
7. Stipules not as above; if any trifoliolate leaves then the lowest leaves simple (9)
9. Lowest (or all) leaves reduced to an oblanceolate or spatulate phyllode. Plants acaulescent, matted, tufted or pulvinate, with small, erect or ascending, unilocular pods ..... Sect. *Drabellae* (p. 282)
9. Lowest leaves pinnate like the rest (10)
10. Pod erect, fully bilocular (11)
11. Stems 0.5–3 dm. long; *flowers* erect at anthesis; *pod* trigonous, strigulose; *stems* from a determinate, superficial root-crown or caudex ..... *A. adsurgens* (p. 610)
11. Stems (with us) almost always taller; *flowers* nodding at full anthesis, retrorsely imbricated; *pod* (with us) terete, commonly glabrous; *stems* arising singly or few together from oblique rhizomes ..... *A. canadensis* (p. 598)
10. Pod variably oriented, but always unilocular (12)
12. Plants strongly caulescent, the peduncles obviously axillary, lateral, and shorter than the developed stem (13)
13. Keel-tip narrowly triangular; *pod* linear-oblanceolate in profile,

laterally compressed ..... *A. miser* (p. 231)
13. Keel-tip broadly rounded; *pod* ovate-oblong in profile, dorsiventrally compressed, sulcate ventrally on either side of the prominent but depressed suture ..... *A. flavus* (p. 398)
12. Plants subacaulescent or shortly caulescent, tufted, the proper stem ordinarily no longer than the scapiform or subscapose inflorescences and longest leaves (14)
14. Calyx-tube shallowly campanulate, 2–4.5 mm. long; *banner* not over 14 mm. long ..... *A. lotiflorus* (p. 994)
14. Calyx-tube deeply campanulate or cylindric, 6–9 mm. long; *banner* 16–22 mm. long ..... *A. missouriensis* (p. 711)
6. Pubescence basifixed (15)
15. Leaves and stems gray-hirsute with widely spreading, filiform but minutely bulbous-based hairs up to 1.1–1.8 mm. long; *pod* pendulous, stipitate, the body linear-oblong, bluntly trigonous, grooved dorsally, glabrous, bilocular ..... *A. Drummondii* (p. 490)
15. Leaves and stems variably pubescent but the hairs shorter and not thickened at base; *pod* otherwise (16)
16. Stipules at least at the lowest 1–3 nodes connate into a bidentate sheath (17)
17. Flower small, the calyx-tube 1.5–4.3 mm., the banner 4.3–12.6 mm. long (18)
18. Wing-petals bidentate at apex; *pod* pendulous, stipitate, laterally compressed, subunilocular, but a narrow, hyaline septum always present ..... *A. aboriginum* (p. 134)
18. Wing-petals entire or obscurely emarginate; *pod* truly unilocular (19)
19. Pod strongly compressed laterally, 2-sided, bicarinate by the salient sutures ..... Sect. *Ervoidei* (p. 342)
19. Pod either terete or ± dorsiventrally compressed, never bicarinate (20)
20. Pod pendulous, stipitate, the body low-convex dorsally, bisulcate ventrally ..... *A. bisulcatus* (p. 408)
20. Pod sessile, not bisulcate ventrally (21)
21. Plants of moist meadows and shores or gravel bars of rivers, rare and far western; *pod* 5.5–11 mm. long, papery-membranous ..... *A. Bodini* (p. 371)
21. Plants of dry prairie soils; *pod* either longer, or thick-textured becoming rugulose-reticulate ..... Sect. *Scytocarpi* (p. 199)
17. Flower larger, the calyx-tube at least 4.5 mm., the banner at least 13 mm. long (22)
22. Leaflets all continuous with the rachis; *pod* fleshy becoming leathery or ligneous, sessile, unilocular; *petals* whitish or ochroleucous ..... Sect. *Pectinati* (p. 423)
22. Leaflets all petiolulate and jointed to the rachis; either the *petals* purple, or if the petals white the *pod* stipitate and thin-textured (23)
23. Flowers narrowly ascending or erect, crowded into ovoid or shortly oblong heads; *pod* erect, stipitate (shortly), the body 7–10 mm. long, trigonous, grooved dorsally, bilocular, the valves hirsute ..... *A. agrestis* (p. 618)
23. Flowers loosely racemose; *pod* much longer, unilocular, glabrous, strigulose, or villosulous (24)
24. Stems erect, from a determinate root-crown; *pod* pendulous, stipitate (unilocular), the valves papery, strigulose or glabrous ..... Sect. *Bisulcati* (p. 407)
24. Stems diffuse or prostrate, from subterranean caudex-branches; *pod* ascending, sessile, humistrate, the valves ± fleshy becoming leathery or pithy, shortly villosulous (25)
25. Pod broadly and plumply ovoid, fully bilocular, the thickly fleshy valves becoming pithy and at least 1 mm. thick when ripe; widespread ..... *A. plattensis* (p. 765)
25. Pod narrower, oblong-ovoid, the thinner valves much less than 1 mm. thick, becoming leathery; local in s.-e. Colo-

rado and extreme w. Oklahoma ..... *A. puniceus* (p. 227)

16. Stipules all free (26)

26. Wing-petals bidentate at apex; *pod* pendulous, stipitate, laterally compressed ..... *A. aboriginum* (p. 134)

26. Wing-petals entire or obscurely emarginate; *pod* sessile or nearly so, if at all stipitate then dorsiventrally compressed (27)

27. Low, tufted, subacaulescent or shortly caulescent plants with proper stems ordinarily no longer than the subscapose inflorescences and longest leaves (28)

28. Pubescence villous-tomentulose, composed of shorter, curly, together with longer, ascending, spirally twisted hairs, turning rusty after drying; *pod* fully bilocular ..... *A. mollissimus* (p. 733)

28. Pubescence strigulose, or if tomentose then softly cottony, the hairs all very fine and sinuous, or if at all villous-hirsute then the hairs all alike, in any case not changing color after drying; *pod* unilocular (29)

29. Pod very large, fusiform, bladdery-inflated, the valves stiffly papery ..... *A. megacarpus* (p. 771)

29. Pod variable in size, but if very large then not inflated, the valves in any case ± fleshy becoming leathery, pithy, or woody ..... Sect. *Argophylli* (p. 622)

27. Strongly caulescent plants, the peduncles obviously axillary, lateral, and shorter than the developed stem (30)

30. Stems erect and ascending in clumps; *flowers* ochroleucous, nodding at full anthesis, ± retrorsely imbricated; *pod* erect on stiffly ascending peduncles; entering the Texas Panhandle from the w. ..... *A. praelongus* (p. 584)

30. Stems diffuse; *flowers* purple or purple-tinged; *pod* humistrate from decumbent peduncles (31)

31. Pod strictly sessile, deciduous when ripe from the receptacle, ovoid, oblong-ellipsoid, or subglobose, fully bilocular, the succulent valves of extremely thick texture, becoming thickly leathery or ultimately pithy, over 1 mm. thick even when fully ripe; widespread ..... Sect. *Sarcocarpi* (p. 752)

31. Pod contracted at base into a short (sometimes obscure) stipe, deciduous with the pedicel, the body oblong, thinly fleshy becoming leathery, subunilocular; entering s. Wyoming from the w. ..... *A. cibarius* (p. 495)

Regional Key IV. The Rocky Mountains s. of Canada (w. Montana and centr. Idaho, s. through Wyoming and Colorado to n. New Mexico; Black Hills, South Dakota)

1. Stipules at the lower, leafless nodes united on the side corresponding with the suppressed petiole into an entire, obtuse blade; *plants* stoloniferous, perennial, with few (7–15) ample, penninerved leaflets, nodding flowers, and pendulous, stipitate, inflated, unilocular pods of papery texture ..... *A. americanus* (p. 98)

1. Stipules at the lower nodes either free or connate, but if united then connate opposite the petiole, or adnate to the suppressed petiole, the sheath so formed emarginate or bidentate; other characters different (2)

2. Leaflets 3–7, linear-elliptic, continuous with the rachis and mucronate or spinulose at apex, commonly becoming stiff and prickly in age. Low, tufted or matted plants with 1–3-flowered racemes of tiny flowers subsessile (rarely pedunculate) in the axils, connate stipules, and small, compressed, 2–8-ovulate, unilocular pods ..... *A. Kentrophyta* (p. 357)

2. Leaflets either more numerous, or jointed to the rachis, commonly both, never spinulose or prickly (3)

3. Leaves all, or all but some lower ones, reduced to a naked, linear-filiform rachis; caulescent plants with pendulous pods (4)

4. Pod (shortly stipitate) bladdery-inflated, the body ovoid or subglobose, thinly papery, mottled ..... *A. ceramicus* (p. 338)

4. Pod linear or narrowly oblanceolate in profile, neither inflated nor mottled (5)

5. Pod stipitate, the body dorsiventrally compressed; *flower* comparatively large, the calyx 6–10 mm., the banner 13.5–19.5 mm. long .....

A. lonchocarpus (p. 278)

5. Pod sessile, the body laterally compressed; *flower* small, the calyx 4–6 mm., the banner 7–11 mm. long ..... *A. convallarius* (p. 245)

3. Leaves all pinnate or trifoliolate, or if some reduced to the petiole this dilated into a phyllode and the plants acaulescent (6)

6. Pubescence of the leaves dolabriform (7)

7. Stipules, at least at the lowest 1–3 nodes, connate into a bidentate sheath (8)

8. Stipules all very large, hyaline, connate into imbricate or (distally) shortly discrete sheaths; *leaves* all trifoliolate. Acaulescent, tufted or pulvinate, or matted shortly caulescent plants (9)

9. Flower long and narrow, the cylindric calyx-tube 6–16 mm., the nearly erect, narrowly oblanceolate or narrowly panduriform banner 12.5–28 mm. long; *flowers* 1–2 together, sessile or nearly so in the axils of leaf-rosettes ..... Sect. *Orophaca* (p. 1150)

9. Flower broader and shorter, the campanulate or deeply campanulate tube 2.8–5 mm. long, the more strongly recurved, obovate-cuneate banner, 6.5–11.5 mm. long; *flowers* commonly pedunculate ..... Sect. *Sericoleuci* (p. 1143)

8. Stipules not as above; if any trifoliolate *leaves* then the lowest ones simple (10)

10. Lowest (or all) leaves reduced to an oblanceolate or spatulate phyllode resembling a simple leaf-blade; the upper leaves simple or 3 (5)-foliolate. Acaulescent, matted, tufted or pulvinate plants with small, erect or ascending, unilocular pods ..... Sect. *Drabellae* (p. 282)

10. Leaves all pinnate (11)

11. Pod erect, fully bilocular (12)

12. Flowers erect at anthesis; *stems* from a determinate, superficial root-crown or caudex ..... *A. adsurgens* (p. 610)

12. Flowers nodding at full anthesis; *stems* from oblique or horizontally creeping rhizomes ..... *A. canadensis* (p. 598)

11. Pod variably oriented but always unilocular (13)

13. Pod linear-oblanceolate or exactly linear in profile, laterally compressed, bicarinate by the sutures ..... *A. miser* (p. 231)

13. Pod ovoid or oblong-ovoid, ± dorsiventrally compressed (14)

14. Stems erect and ascending; *pod* flat or low convex dorsally, bisulcate ventrally, the ventral suture prominent but depressed and lying in a double groove ..... *A. flavus* (p. 398)

14. Stems prostrate, or diffuse with ascending tips; *pod* (with us) sulcate dorsally at least toward the base, carinate ventrally by the suture ..... *A. humistratus* (p. 383)

7. Stipules all free (15)

15. Peduncles and racemes erect, the flowers nodding at full anthesis, the pods erect, narrowly oblong, bilocular ..... *A. terminalis* (p. 523)

15. Peduncles incurved-ascending at anthesis, procumbent in fruit, the flowers ascending, the pods ascending but humistrate, commonly unilocular, if rarely bilocular then subglobose (16)

16. Calyx-tube shallowly campanulate, 2–4.5 mm. long; *banner* not over 14 mm. long ..... *A. lotiflorus* (p. 994)

16. Calyx-tube cylindric or deeply campanulate, 6–10.5 mm. long; *banner* 16–22 mm. long ..... Sect. *Argophylli* (p. 622)

6. Pubescence basifixed (17)

17. Leaves and stems hirsute with widely spreading, filiform but minutely bulbous-based hairs over 1 mm. long. Strongly caulescent plants with large, nodding, white flowers and pendulous, stipitate pods, the body linear-oblong, bluntly trigonous, grooved dorsally, fully bilocular ..... *A. Drummondii* (p. 490)

17. Leaves and stems not hirsute, or if at all so the hairs filiform throughout and the pod different in several features (18)

18. Stipules, at least at the 1–3 lowest nodes, connate into a sheath (19)

19. Flower large, the calyx-tube (4.7) 5–10 mm., the banner (13) 13.5–24 mm. long (20)

20. Leaflets all decurrent into the rachis (not jointed or petiolulate (21)

21. Stout, ill-scented, xerophytic plants with really large flowers, the banner at least 14.5 mm., usually over 16 mm. long; *pod*

fleshy becoming leathery or subligneous ..... Sect. *Pectinati* (p. 423)

21. Weak and slender, mesophytic plants with comparatively small flowers, the banner not over 13.5 mm. long; *pod* papery ..... *A. diversifolius* (p. 249)

20. Leaflets all jointed (22)

22. Flowers erect, crowded into ovoid or subglobose heads; *pods* erect, shortly stipitate, small, the body (not over 1 cm. long) trigonous, fully bilocular, hirsute ..... *A. agrestis* (p. 618)

22. Flowers (ascending or nodding) loosely racemose; *pods* either unilocular or longer, usually both, glabrous or strigulose (23)

23. Stems arising together from a determinate root-crown at or just below soil-level, erect and ascending in clumps; ill-scented, coarse plants with nodding flowers and pendulous, stipitate, unilocular (trigonous or ventrally bisulcate) *pods* of papery texture ..... Sect. *Bisulcati* (p. 407)

23. Stems arising singly or few together from subterranean caudex-branches, their buried portion consisting of several leafless internodes separated by stipule-sheaths; scentless plants; *pods* either ascending (and shortly stipitate) and unilocular, or pendulous (triquetrous) and fully bilocular (24)

24. Flowers ochroleucous, nodding at full anthesis; *pods* pendulous, long-stipitate, triquetrous, fully bilocular ..... *A. scopulorum* (p. 198)

24. Flowers purple, ascending at anthesis; *pods* ascending, short-stipitate, dorsiventrally compressed, usually uni-, rarely subunilocular ..... *A. Hallii* (p. 223)

19. Flower smaller, the calyx-tube 1.5–4 (4.3) mm., the banner 4.5–13 mm. long (25)

25. Pod broadly ovoid or subglobose, inflated, fully bilocular (26)

26. Petals little or not graduated, the banner hardly longer than the broad and prominent, truncate keel ..... Sect. *Platytropides* (p. 977)

26. Petals strongly graduated, the banner much longer than the keel ..... *A. lentiginosus* (p. 911)

25. Pod variable in outline, solid or slightly turgid, or if (rarely) inflated then unilocular (27)

27. Stems arising from buried points of renewal on the subterranean root-crown or rhizome-like caudex-branches (28)

28. Petals irregularly graduated, the broad and prominent keel a trifle longer and nearly twice as broad as the narrow, whitish wings; *pod* pendulous, stipitate, the body trigonous, semibilocular, pilose (usually with black or partly black hairs) ..... *A. alpinus* (p. 103)

28. Petals regularly graduated; *pod* either sessile or unilocular (29)

29. Terminal and lateral leaflets continuous with the rachis but often dilated and with grasslike blades ..... Sect. *Genistoidei* (p. 230)

29. Leaflets all jointed, or if the terminal one continuous with the rachis its blade filiform (30)

30. Racemes 1–6-flowered; *stems* low, rarely over 2 dm. long (if over 2 dm. then the racemes not over 4-flowered) (31)

31. Pod ascending (humistrate) obliquely ovoid, slightly incurved; *petals* purplish, the keel ± 9–10 mm. long; *herbage* silvery or cinereous; high alpine in centr. Colorado ..... *A. molybdenus* (p. 114)

31. Pod pendulous, oblong- or lance-ellipsoid, slightly decurved; *petals* white (except for purple keel-tip), the keel 6–7.5 mm. long; *herbage* green; moist mountain meadows, at middle elevations, rare but widespread ..... *A. leptaleus* (p. 111)

30. Racemes 7–35-flowered; *stems* mostly taller, 1.5–6 dm. long (if less than 2 dm. then the more vigorous racemes over 10-flowered) (32)

32. Peduncles solitary in the leaf-axils; *pod* either laterally

or somewhat dorsiventrally compressed, if less than 1 cm. long and less than 10-ovulate then laterally compressed and two-sided; widespread ..... Sect. *Scytocarpi* (p. 199)

32. Peduncles paired (or paired with a branchlet) at most distal axils; *pod* 6–9 mm. long, 4–6-ovulate, obcompressed, openly sulcate dorsally; Gunnison Valley, Colorado, very local ..... *A. microcymbus* (p. 192)

27. Stems arising together from a determinate, superficial root-crown or caudex (33)

33. Lower stipules large, obtuse, several-nerved, mostly fully amplexicaul (and often only obscurely connate); *pod* pendulous and stipitate or deflexed and sessile, subunilocular (a narrow, hyaline septum always present) (34)

34. Wings cleft at apex into 2 unequal lobes ..... *A. aboriginum* (p. 134)

34. Wings entire or shallowly emarginate ..... Sect. *Oroboidei* (p. 115)

33. Lower stipules small, strongly connate-sheathing; *pod* unilocular (35)

35. Pod stipitate, the stipe usually as long as the calyx-tube or longer (36)

36. Body of the pod laterally compressed, two-sided, carinate by both sutures ..... Sect. *Ervoidei* (p. 342)

36. Body of the pod dorsiventrally compressed, low-convex dorsally, bisulcate ventrally ..... *A. bisulcatus* (p. 408)

35. Pod sessile or nearly so (37)

37. Pod linear or linear-oblanceolate in profile, 1.1–2.5 cm. long; *keel-tip* narrowly triangular, beaklike ..... *A. miser* (p. 231)

37. Pod oblong-elliptic to ovoid or subglobose, rarely over 1 cm. long; *keel-tip* bluntly deltoid (38)

38. Pod laterally compressed, bicarinate by the sutures, two-sided, not at all inflated ..... *A. vexilliflexus* (p. 349)

38. Pod scarcely or subtrigonously compressed, not carinate by the sutures, ± inflated or strongly tumid (39)

39. Calyx-tube 1.5–2.2 mm. long; *keel* ± 3.5–5 mm. long; *pod* pilosulous; Montana and Idaho ..... *A. microcystis* (p. 355)

39. Calyx-tube 2.4–4 mm. long; *keel* 5.5–9 mm. long; *pod* minutely (but sometimes densely) strigulose; Wyoming and Colorado (and again far n.-ward, but not yet found in Montana) ..... *A. Bodini* (p. 371)

18. Stipules all free (40)

40. Flower small, the calyx-tube 1.5–4 mm., the banner 5–12.5 mm. long (if the banner over 11 mm. the wings cleft at apex into 2 unequal lobes) (41)

41. Peduncles dimorphic, the early ones short, subradical, 1-flowered, the later ones elongate, remotely 2–7-flowered; *flowers* tiny, the banner 4–7 mm. long; *pod* inversely boat-shaped ..... *A. Brandegei* (p. 479)

41. Peduncles not dimorphic; *flowers* usually a little larger, or more numerous; *pod* never inversely boat-shaped (42)

42. Lower stipules large, obtuse, several-nerved, fully amplexicaul or nearly so; *pod* pendulous and stipitate or deflexed and sessile, subunilocular, a narrow septum always present.—Return to choice 34/34.

42. Lower stipules small, ± semiamplexicaul; if the pod deflexed and stipitate then fully bilocular, if subunilocular then ascending or bladdery-inflated (43)

43. Pod greatly inflated, bladdery ..... Sect. *Inflati* (p. 825)

43. Pod not inflated (44)

44. Pod pendulous, shortly stipitate, the body linear-oblong, trigonous, bilocular; centr. Idaho and w. Wyoming ..... *A. Paysonii* (p. 445)

44. Pod ascending (mostly humistrate), sessile, obliquely ovoid to narrowly oblong-ellipsoid, uni- or subunilocular; Colo-

rado (Front Range) ..... *A. sparsiflorus* (p. 899)

40. Flower larger, the calyx-tube over 4 mm., the banner 13–25 mm. long (45)

45. Terminal leaflets of at least some upper leaves continuous with the rachis (in the common sp. the upper leaves reduced to the naked rachis); *pod* pendulous, long-stipitate, narrowly elliptic to linear or clavately linear in profile, variably compressed, unilocular ..... Sect. *Lonchocarpi* (p. 252)

45. Terminal leaflets all jointed, the leaves all imparipinnate; *pod* either sessile, or elevated on a gynophore, or if stipitate then erect and either bilocular or much broader in outline (46)

46. Pod elevated on a stipelike gynophore, the sessile body either inflated and bladdery or fleshy becoming leathery, uni- or subunilocular ..... Sect. *Megacarpi* (p. 770)

46. Pod either sessile on the receptacle or truly stipitate (47)

47. Pod stipitate (the stipe sometimes short and concealed by the calyx) (48)

48. Racemes short, the axis not over 1.5 cm. long in fruit; *stems* diffuse; *pods* humistrate, the stipe not over 2 mm. long, the body obcompressed, 7–10 mm. in diameter, subunilocular; Yellowstone region s.-ward ..... *A. cibarius* (p. 495)

48. Racemes loose and open, the fruiting axis much longer; *stems* erect; *pods* erect from ascending peduncles, either much narrower or elevated on a much longer stipe, in any case bilocular or almost so ..... Sect. *Reventi-arrecti* (p. 515)

47. Pod exactly sessile (49)

49. Pubescence villous-tomentulose, composed of shorter, sinuous and longer, straightish, spirally twisted villi, the whole turning rusty when dried; *pod* glabrous, fully bilocular ..... *A. mollissimus* (p. 733)

49. Pubescence various, but if at all tomentose then the hairs all sinuous (in any case none spirally twisted) and the pod unilocular and pubescent (50)

50. Pod plumply ovoid-acuminate or subglobose, fully bilocular, the septum broad and complete (51)

51. Pod turgid or inflated, papery or leathery in texture, the valves much less than 1 mm. thick even when first formed ..... *A. lentiginosus* (p. 911)

51. Pod solid, thickly succulent, the valves much over 1 mm. thick when first formed, drying very thickly leathery or ultimately pithy ..... *A. crassicarpus* (p. 753)

50. Pod variable in outline but always uni- or subunilocular, the septum when present very narrow or obscure (52)

52. Stems and peduncles erect; *pods* erect or nearly so, persistent and dehiscent on the raceme (53)

53. Ill-scented plants of the s. Rocky Mountains (not n. of Colorado), with subunilocular, 22–84-ovulate pods and nodding flowers ..... Subsect. *Pattersoniani* (p. 583)

53. Scentless plants of mountainous centr. Idaho, with truly unilocular, 14–18-ovulate pods and ascending flowers ..... *A. adanus* (p. 521)

52. Stems (when present) diffuse or prostrate; *peduncles* procumbent in fruit, the *pods* humistrate, promptly deciduous except in *A. cibarius* (54)

54. Plants acaulescent, subacaulescent and tufted, or if strongly caulescent the herbage cottony-tomentose, long-villous, or hirsute; *pod* readily deciduous ..... Sect. *Argophylli* (p. 622)

54. Plants caulescent, thinly short-pubescent, the herbage green or greenish; *pod* persistent or deciduous with the pedicel ..... *A. cibarius* (p. 495)

Regional Key V. The Columbia Basin (Washington e. of the Cascade crest and the lower Columbia and Fraser Valleys in s. British Columbia; lower Salmon and Clearwater Valleys in w.-centr. Idaho; e. Oregon s.-ward to the Columbia-Great Basin watershed and the head of the Grand Canyon of the Snake River)

1. Stipules at the lower, leafless nodes united on the side corresponding with the suppressed petiole into an entire, obtuse blade; *plants* stoloniferous, perennial, with few (7–15), ample, penninerved leaflets, nodding flowers, and pendulous, stipitate, inflated, unilocular pods of papery texture; *ovules* 6–10 ..... *A. americanus* (p. 98)
1. Stipules at the lower nodes either free or connate, but if united then connate opposite the petiole or adnate to the suppressed petiole, the sheath so formed emarginate or bidentate; other characters different (2)
2. Leaflets 3–7, linear-elliptic, continuous with the rachis and mucronate or spinulose at apex, becoming stiff and prickly in age; low tufted or matted plants with 1–3-flowered racemes of tiny flowers subsessile in the leaf-axils, connate stipules, and small, compressed, 2–4-ovulate, unilocular pods ..... *A. Kentrophyta* (p. 357)
2. Leaflets either more numerous, or jointed to the rachis, commonly both, never spinulose or prickly in age (3)
3. Plants annual. Pod papery-membranous, sessile (4)
4. Racemes 2–8-flowered; *leaflets* mostly linear-oblong or oblanceolate; *pod* lunately half-ovoid, truly unilocular ..... *A. Geyeri* (p. 893)
4. Racemes mostly 7–15-flowered; *leaflets* of a broader type, mostly oblong-ovate or obovate-cuneate; *pod* highly variable in outline but almost always subuni- or semibilocular ..... *A. diaphanus* (p. 903)
3. Plants perennial (5)
5. Pubescence of the leaves dolabriform (6)
6. Plants strongly caulescent, the peduncles obviously lateral and axillary (7)
7. Flowers nodding at full anthesis; *stems* arising from oblique rhizomes, commonly more than 3 dm. long; *lateral* faces of the persistent pod rounded ..... *A. canadensis* (p. 598)
7. Flowers erect at full anthesis; *stems* arising from a determinate, superficial root-crown or caudex, commonly 1–3 dm. long; *lateral* faces of the deciduous pod flattened ..... *A. adsurgens* (p. 610)
6. Plants subacaulescent, tufted, the peduncles radical or nearly so ..... *A. lotiflorus* (p. 994)
5. Pubescence basifixed (8)
8. Petals irregularly graduated, the erect wings longest, 17.5–23.5 mm. long, the whitish blades notched at apex and contrasting with a roseate banner and keel. Plants robust, hirsute, with long (2–4 cm.) sessile, narrowly lanceolate, slightly incurved, compressed-triquetrous, glabrous, fully bilocular pods ..... *A. succumbens* (p. 1079)
8. Petals regularly graduated, or if irregularly so then all much shorter; *pod* otherwise (9)
9. Stipules all, or at least those at the lowest 2–3 nodes, connate-amplexicaul (10)
10. Pod pendulous, stipitate, the valves papery or papery-membranous (11)
11. Body of the pod subunilocular, the septum narrow, hyaline, but always present (12)
12. Stems from very slender, subterranean caudex-branches; *petals* irregularly graduated, the wings a trifle shorter and scarcely half as broad as the prominent keel; *pod* pilosulous (nearly always with black or partly black hairs), the trigonous body openly grooved dorsally ..... *A. alpinus* (p. 103)
12. Stems from a determinate, superficial root-crown; *keel* shorter and little broader than the wings; *pod* subglabrous or strigulose, the body laterally compressed or subtrigonous, but if the latter only flattened and not grooved dorsally (13)
13. Wings bidentate at apex; *pod* laterally compressed; *leaflets* mostly narrowly elliptic ..... *A. aboriginum* (p. 134)
13. Wings entire or shallowly emarginate at apex; *pod* trigonously compressed; *leaflets* mostly of a broader type ..... *A. Robbinsii* (p. 121)
11. Body of the pod truly unilocular, the body either linear-oblong to narrowly elliptic and two-sided, or bladdery-inflated (14)

14. Flower very small, the banner 6–9 mm. long; *pod-body* 7–17 mm. long, 4–9 ovulate, two-sided, like the stipules turning black when dried ..... *A. tenellus* (p. 344)
14. Flower larger, the banner 9–15.5 mm. long; *pod-body* either bladdery-inflated or compressed and two-sided, but if the latter 17–30 mm. long; *ovules* 10–30, not less than 20 if the banner less than 10 mm. long; *pod* not blackening ..... Sect. *Cusickiani* (p. 317)

10. Pod variously oriented, but erect if stipitate (15)
15. Flower small, the calyx-tube 1.3–4.2 mm., the banner 4.5–12 mm. long (16)
16. Pod variably compressed or inflated, truly unilocular (17)
17. Pod linear or linear-oblanceolate in profile, laterally compressed, at least 11 mm. long ..... *A. miser* (p. 231)
17. Pod of broader outline and if laterally compressed then shorter (18)
18. Pod ± 4 mm. long, laterally compressed, 2–3-ovulate; *leaflets* 5–11, obovate-cuneate or obcordate, not over 5 mm. long; extremely delicate, prostrate plants of the Blue Mountain system, Oregon ..... *A. tegetarioides* (p. 395)
18. Pod over 5 mm. long, ± bladdery-inflated, 5–9-ovulate; *leaflets* 7–15, some of them over 5 mm. long; interior Washington and s. British Columbia (19)
19. Pod very obliquely half-ovoid, 1–2 cm. long, the ventral suture straight or concavely arched; Cascade Range in Klickitat County ..... *A. Pulsiferae* (p. 968)
19. Pod plumply obovoid-ellipsoid or subglobose, less oblique, the sutures both convexly arched (even though the ventral one less strongly than the dorsal); extreme e. Washington and s. British Columbia ..... *A. microcystis* (p. 355)
16. Pod triquetrous or compressed-triquetrous, subuni- to fully bilocular (20)
20. Pod erect, stipitate, the body 1.6–2.7 cm. long; *banner* over 10 mm. long; *valves* of the pod fleshy becoming leathery ..... *A. Leibergi* (p. 556)
20. Pod declined or deflexed, sessile or almost so, the body less than 1 cm. long; *banner* 7.5 mm. long or less; *valves* of the pod thin-walled, papery (21)
21. Pod fully bilocular; xerophytic plants of low elevations with lower stipules no larger than succeding ones (22)
22. Terminal leaflet of the crowded leaves continuous with the rachis, which becomes stiff and subspinose in age; *petioles* persistent as a thatch on the caudex-branches; upper Deschutes Valley, Oregon ..... *A. Peckii* (p. 468)
22. Terminal leaflet jointed to the rachis of the well-spaced leaves; *petioles* neither stiffened nor persistent as a thatch; Big Bend of the Columbia and vicinity ..... *A. caricinus* (p. 1111)
21. Pod subunilocular; mesophytic plants with lower stipules large, obtuse, veiny ..... *A. eucosmus* (p. 116)
15. Flower larger, the calyx-tube 4.5–9 mm., the banner 13–25.5 mm. long (23)
23. Flowers erect, crowded into ovoid heads; *pod* shortly stipitate, the short body trigonous, grooved dorsally, hirsute; *stems* from a subterranean root-crown ..... *A. agrestis* (p. 618)
23. Flowers ± loosely racemose; *pod* either sessile or stipitate, but if the latter the flowers nodding and the valves in any case not more than thinly strigulose, often glabrous ..... Sect. *Conjuncti* (p. 549)

9. Stipules all free (24)
24. Lowest stipules largest, broad, obtuse, several-nerved, fully amplexicaul (and often obscurely connate)—Return to choice 13/13.
24. Lowest stipules not as above (25)
25. Flower small, the banner 5.5–13 mm. long (26)
26. Racemes paired at most axils. Slender, prostrate mesophytes of lake shores and stream banks with tiny, whitish flowers and

very small, narrowly oblong, trigonous, dorsally grooved, fully bilocular pods ..... *A. Lemmoni* (p. 1109)

26. Racemes solitary in the axils (27)
27. Pubescence of the stems and leaves short, mostly appressed and strigulose, but even if villosulous the longest hairs not over 0.7 mm. long (28)
28. Terminal leaflet (at least of most leaves) filiform, continuous with the leaf-rachis. Racemes remotely flowered; *pod* pendulous, slightly decurved, inversely boat-shaped, unilocular ..... *A. atratus* var. *owyheensis* (p. 475)
28. Terminal leaflets all jointed, broader than filiform even though sometimes linear (29)
29. Pod (pendulous) stipitate, the stipe sometimes concealed by the calyx (30)
30. Plants subacaulescent, the peduncles not truly radical but appearing subscapose, longer than the true stems; *racemes* 2–8-flowered; *pod* slightly decurved, inversely boat-shaped, mottled ..... *A. salmonis* (p. 477)
30. Plants strongly caulescent, the peduncles clearly lateral and shorter than the stems; *racemes* (the more vigorous ones) over 10-flowered; *pod* either straight or incurved ..... Sect. *Miselli* (p. 438)
29. Pod sessile (31)
31. Calyx-tube shallowly campanulate, 2–2.6 mm. long; *pod* either ± trigonous or compressed-trigonous, then grooved only dorsally and semibilocular, or ovoid and inflated, then subunilocular; John Day and lower Columbia Valleys ..... *A. diaphanus* (p. 903)
31. Calyx-tube deeply campanulate or cylindric, 2.8–4.2 mm. long; *pod* usually bladdery-inflated, if little so then subterete or grooved ventrally, in any case fully bilocular below the beak ..... *A. lentiginosus* (p. 911)
27. Pubescence of the stems and leaves villous or cottony-tomentose, the longest hairs 1–2 mm. long (32)
32. Plants erect or diffuse; leaflets 11–25; *calyx-tube* campanulate, 1.5–4.5 mm. long; *racemes* 10–35-flowered; *pod* straight, strigulose or pilosulous, fully bilocular, 4–10-ovulate ..... Sect. *Chaetodontes* (p. 1101)
32. Plants matted; *leaflets* 5–7 (11); *calyx-tube* deeply campanulate or subcylindric, 4.5–6.5 mm. long; *racemes* 2–7-flowered; *pod* strongly incurved, densely silky-hirsute, unilocular, 14–20-ovulate ..... *A. Purshii* var. *lagopinus* (p. 683)

25. Flower larger, the banner 13–25 mm. long (33)
33. Pod at once pendulous and stipitate (34)
34. Body of the pod trigonously compressed, grooved dorsally ..... Sect. *Miselli* (p. 438)
34. Body of the pod ± laterally compressed, or at least both sutures salient at maturity (35)
35. Flowers at anthesis ascending; *calyx-tube* not tumid, little oblique and never gibbous dorsally at base ..... Sect. *Podosclerocarpi* (p. 312)
35. Flowers at anthesis nodding; *calyx-tube* tumid, strongly oblique or commonly saccate dorsally at base ..... Sect. *Collini* (p. 300)
33. Pod either sessile (sometimes elevated on a gynophore) or truly stipitate, but if the latter then erect or ascending (36)
36. Body of the pod elevated on a stout, stipelike gynophore, dorsiventrally compressed, leathery, glabrous, subunilocular ..... *A. Beckwithii* (p. 779)
36. Body of the pod sessile or truly stipitate (37)
37. Plants densely silky- or cottony-tomentose, the leaves canescent or silvery; *pods* densely long-hirsute or hirsute-tomentose ..... Sect. *Argophylli* (p. 622)
37. Plants strigulose or subglabrous, the leaves green or sub-

cinereous; *pods* glabrous or strigulose (38)
38. Stems, peduncles, and pods all erect; *peduncles* 7–30 cm. long (39)
39. Pod both stipitate and somewhat laterally compressed, bicarinate by the sutures, unilocular; *flowers* ascending, but the calyx-tube gibbous dorsally at base; *stems* from a buried root-crown, subterranean for a space of 1.5–5 cm. ..... *A. Tweedyi* (p. 310)
39. Pod either sessile or stipitate, but if the latter then grooved dorsally and semibi- to subunilocular; *flowers* variously oriented, but if ascending the calyx-tube not dorsally gibbous and if gibbous then nodding; *stems* from a superficial root-crown or caudex ..... Sect. *Reventi-arrecti* (p. 515)
38. Stems diffuse or prostrate, the peduncles incurved-ascending at anthesis, procumbent in fruit, the pods humistrate; *peduncles* 1–6 cm. long (39)
40. Pod unilocular; *ovules* ± 50; *leaflets* 5–13, narrowly oblanceolate-elliptic ..... *A. columbianus* (p. 649)
40. Pod fully bilocular or almost so; *ovules* 22–38; *leaflets* of a broader type (41)
41. Pod sessile, deciduous from the receptacle; e. Oregon ..... *A. lentiginosus* var. *platyphyllidius* (p. 930)
41. Pod stipitate, deciduous with the pedicel; Grand Canyon of the Snake River ..... *A. vallaris* (p. 504)

Regional Key VI. The Great Basin (Nevada, except for the Mohavean sector at the s., Utah w. of the Wasatch crest and headwaters of the Virgin, and transmontane California n. from Inyo County, n. to transmontane Oregon s. of the Columbia drainage and to the Snake River Valley in Idaho)

1. Annuals of 3–4 months duration, small-flowered, the banner not over 7.5 mm. long (2)
2. Pod obliquely ovoid, bladdery-inflated, unilocular ..... Sect. *Inflati* (p. 825)
2. Pod linear-oblong in profile, triquetrous, grooved dorsally, usually fully bilocular (the septum sometimes reduced to a vestige) ..... Sect. *Leptocarpi* (p. 1008)
1. Perennial, but if flowering the first year or appearing annual, or actually monocarpic, the flowers much larger, the banner at least 10 mm. long (3)
3. Leaflets 3–7, linear-elliptic, continuous with the rachis and mucronate or spinulose at apex, becoming stiff and prickly in age; low tufted and matted plants with 1–3-flowered racemes (commonly subsessile in the leaf-axils, rarely pedunculate), connate stipules, and small, compressed, few-ovulate, unilocular pods ..... *A. Kentrophyta* (p. 357)
3. Leaflets either more numerous, or jointed to the rachis, commonly both, never spinulose or prickly (4)
4. Stipules all, or at least those at the first 1–3 nodes, connate into a bidentate sheath (5)
5. Pubescence dolabriform (6)
6. Leaves all, or at least the lowest, reduced to simple, oblanceolate or spatulate phyllodes. Dwarf, tufted or matted, acaulescent, silvery plants with small, ascending, two-sided, unilocular pods ..... *A. spatulatus* (p. 283)
6. Leaves all pinnate, or all trifoliolate, or if some reduced to the rachis this filiform and the plants caulescent (7)
7. Plant acaulescent, densely tufted; leaves all trifoliolate ..... *A. gilviflorus* (p. 1151)
7. Plant caulescent; *leaves* all pinnate or simple (8)
8. Leaves mostly, or at least the upper ones, reduced to the filiform rachis; *pod* pendulous, bladdery-inflated, mottled ..... *A. ceramicus* (p. 338)
8. Leaves all regularly pinnate; *pod* erect or ascending, not inflated, not mottled (9)
9. Coarse, erect plants, the stems arising from horizontal, cordlike rhizomes; *calyx-tube* gibbous dorsally at base; *flowers* nodding, in dense, oblong heads; *banner* at least 14 mm. long ..... *A. canadensis* (p. 598)
9. Slender, diffuse or tufted plants, the stems arising from a determi-

nate, superficial root-crown or caudex; *calyx-tube* not gibbous; *flowers* ascending, ± loosely racemose; *banner* not over 13 mm. long (10)

10. Banner 7–9.5 mm. long; *stems* prostrate, radiating, forming loose mats; *pod* not bisulcate ventrally ..... *A. humistratus* var. *humivagans* (p. 388)

10. Banner 11.5–13 mm. long; *stems* tufted, ascending; *pod* dorsiventrally compressed, low-convex dorsally and bisulcate ventrally ..... *A. flavus* var. *candicans* (p. 401)

5. Pubescence basifixed (11)

11. Uppermost leaves, sometimes all, with lateral leaflets reduced in size or number, or wanting, the uppermost commonly represented by a naked, filiform rachis (sometimes dilated at tip) or by a simple grasslike blade not differentiated into leaflet and petiole (12)

12. Pod pendulous, greatly inflated, bladdery, the valves papery or papery-membranous ..... Sect. *Cusickiani* (p. 317)

12. Pod not inflated, oblong or linear in profile (13)

13. Flower comparatively large, the purple banner 15–20 mm. long; stout rushy plants with erect, sessile, fleshy and ultimately subligneous pods bicarinate by the prominent cordlike sutures ..... *A. toanus* (p. 428)

13. Flower smaller, or whitish, or both; slender plants with pendulous, narrowly oblong or linear pods of papery texture, the sutures salient but subfiliform (14)

14. Pod long-stipitate; n.-e. California ..... Subsect. *Inversi* (p. 319)

14. Pod sessile; range otherwise ..... Sect. *Genistoidei* (p. 230)

11. Leaves all imparipinnate, the leaflets (either terminal or lateral) sometimes continuous with the rachis but not reduced in size or number (15)

15. Banner and wings pubescent dorsally (marcescent); dwarf, tufted or matted, silvery plants of the n. Sierra Nevada and Mt. Rose, Nevada, with small, fully bilocular pods invested by the calyx ..... *A. Austinae* (p. 1118)

15. Banner and wings glabrous (16)

16. Flowers erect or nearly so, large (the banner (15) 17–22 mm. long), disposed in dense, ovoid heads subtended by broad, mostly oblong and obtuse, herbaceous bracts; *pod* erect, shortly stipitate, the body up to 1 cm. long, trigonous, fully bilocular, the valves hirsute ..... *A. agrestis* (p. 618)

16. Flowers variously oriented, mostly spreading or nodding, in any case ± loosely racemose and often smaller; *pod* otherwise (17)

17. Plants acaulescent or nearly so, the stems not over 2 cm. long, the stipules imbricated or contiguous (18)

18. Pod greatly inflated, bladdery; *leaflets* all (or all but the terminal one) jointed to the rachis (19)

19. Petals little graduated, the broad, truncate keel as long or nearly as long as the banner; *pod* fully bilocular; *ovules* 26–34 ..... *A. platytropis* (p. 979)

19. Petals strongly graduated, the keel-tip rounded; *pod* unilocular; *ovules* 10–14 ..... Sect. *Jejuni* (p. 379)

18. Pod linear-oblong or -oblanceolate in profile, not at all inflated; many *leaflets* decurrent into the rachis; cf. ..... *A. miser* var. *tenuifolius* (p. 237)

17. Plants caulescent, usually strongly so (20)

20. Petals irregularly graduated, the whitish wings a trifle shorter and scarcely half as wide as the prominent, purple-tipped keel; *stems* from slender, subterranean caudex-branches; *pod* pendulous, stipitate, trigonous, grooved dorsally, subunilocular, pilosulous with dark hairs ..... *A. alpinus* (p. 103)

20. Petals regularly graduated, the banner longest and keel shortest (or if rarely somewhat irregular, then the wings longest); *stems* and *pod* not both as above (21)

21. Flower comparatively large, the calyx-tube 4.1–9.2 mm., the banner 12.1–25.5 mm. long (if any doubt follow either choice) (22)

22. Pod stipitate (23)

23. and pendulous (24)
24. Body of the pod linear-oblong, trigonous, grooved dorsally, glabrous, bilocular. Plants hirsute with divergent, minutely bulbous-based hairs at least 1 mm. long ..... *A. Drummondii* (p. 490)
24. Body of the pod not grooved dorsally, unilocular (25)
25. Pod low-convex dorsally and bisulcate ventrally ..... *A. bisulcatus* (p. 408)
25. Pod laterally compressed or inflated, never bisulcate ventrally (26)
26. Calyx-tube cylindric, gibbous dorsally at base, ± 7.5–10 mm. long; *petals* yellowish; pod fleshy becoming leathery, the sutures both prominent and cordlike, the middle of the valves laterally distended ..... *A. Gibbsii* (p. 307)
26. Calyx-tube campanulate, not gibbous and not over 6 mm. long; *petals* whitish or purple; *pod* papery, either linear to linear-oblong in profile and two-sided, or bladdery-inflated ..... Sect. *Cusickiani* (p. 317)
23. and erect, inflated (but of rather firm texture) (27)
27. Stipe of the pod 4–12 mm. long, the body strongly incurved, fully bilocular below the beak; Sierra Nevada. ..... *A. Bolanderi* (p. 558)
27. Stipe of the pod 9–19 mm. long, the body subsymmetrically ovoid, unilocular; local in s.-w. Utah ..... *A. ampullarius* (p. 568)
22. Pod sessile (28)
28. and erect, persistent, dorsiventrally compressed, subunilocular; *pubescence* of stems and leaves strigulose; s.-e. Oregon and s.-w. Idaho ..... *A. conjunctus* (p. 550)
28. and spreading or declined, deciduous, semi- or fully bilocular; *pubescence* of stems and leaves villosulous; Sierra Nevada and adjoining foothills, California and w. Nevada (29)
29. Pod compressed-triquetrous, fully bilocular, the cross-section deltoid or triangular; *flowers* racemose, the fruiting axis 2.5–11 cm. long ..... Subsect. *Andersoniani* (p. 1115)
29. Pod ± dorsiventrally compressed, semibilocular, the cross-section transversely oblong ± constricted at the sutures; *flowers* subumbellate, the fruiting axis less than 1.5 cm. long ..... *A. monoensis* (p. 965)
21. Flower small, the calyx-tube 1.3–4 mm., the banner 5–12 mm. long (30)
30. Lowest stipules largest, obtuse, several-nerved, often only obscurely connate; *pod* declined or pendulous, stipitate or subsessile, papery, subunilocular; with us only in the East Humboldt Mountains, Nevada (31)
31. Wing-petals deeply cleft at apex; *pod* laterally compressed, stipitate ..... *A. aboriginum* (p. 134)
31. Wing-petals entire or shallowly emarginate; *pod* obscurely trigonous, subsessile ..... *A. Robbinsii* var. *occidentalis* (p. 128)
30. Lowest stipules otherwise (or if at all similar the pod and range otherwise) (32)
32. Pod both stipitate and unilocular, always pendulous (33)
33. the body low-convex dorsally and bisulcate ventrally ..... *A. bisulcatus* (p. 408)
33. the body either laterally flattened and two-sided, or bladdery-inflated (34)
34. Flower very small, the banner 6–9 mm. long; *pod-body* laterally compressed and two-sided, 7–17 mm. long, 4–9-ovulate, like the stipules turning black when dried ..... *A. tenellus* (p. 344)
34. Flower larger, the banner 9–15.5 mm. long; *pod-*

body either bladdery-inflated or compressed and two-sided, but if the latter then 17–30 mm. long; *ovules* 10–30, not less than 20 if the banner less than 10 mm. long; *pod* not blackening ..... Sect. *Cusickiani* (p. 317)

32. Pod either stipitate or sessile, but if stipitate either erect and unilocular, or pendulous and bilocular (35)

35. Pod stipitate (36)

36. and pendulous, the body trigonous and bilocular; *leaflets* 15–23, linear or nearly so ..... Sect. *Neonix* (p. 464)

36. and incurved to erect, the body laterally compressed, unilocular; *leaflets* 9–13, mostly obcordate, leathery; local around Carson Sink, Nevada ..... *A. porrectus* (p. 566)

35. Pod sessile (37)

37. Stems arising from a buried root-crown, their bases leafless and glabrous (38)

38. Keel-tip narrowly triangular, beaklike; *style* exserted; *pod* subsymmetrically ovoid or globose, bladdery, fully bilocular; low villosulous plants of s.-w. Utah ..... *A. striatiflorus* (p. 973)

38. Keel-tip bluntly deltoid or rounded; *style* included; *pod* strongly oblique, half-ovoid, or oblong-ellipsoid and incurved, semibi- or unilocular, in Utah unilocular (39)

39. Stems 1.5–7 dm. long, branched upon emergence from the ground; *pod* inflated, unilocular, continuous with the receptacle and thus not readily deciduous; *racemes* 10–37-flowered; s.-w. Utah ..... *A. subcinereus* (p. 142)

39. Stems up to 2.5 dm. long, but not over 1 dm. long in Utah; *pod* turgid or inflated, readily disjointing from the receptacle; *racemes* very shortly 3–13-flowered ..... Sect. *Monoenses* (p. 964)

37. Stems arising from a superficial root-crown or caudex (40)

40. Petioles becoming stiff and persisting as a thatch on the caudex-branches. Pod very small, bilocular ..... *A. Peckii* (p. 468)

40. Petioles flaccid, deciduous (41)

41. Pod narrowly oblong to lentiform, trigonous or compressed-trigonous, fully bilocular ..... Sect. *Chaetodontes* (p. 1101)

41. Pod obliquely ovate to linear-oblanceolate or linear in profile, two-sided, unilocular (42)

42. Pod linear or linear-oblanceolate in profile, 8–19-ovulate; e.-centr. Nevada n.- and e.-ward ..... *A. miser* (p. 231)

42. Pod obliquely ovate in profile, 2–9-ovulate; either n.-e. California and adjoining Nevada, or e. Oregon (43)

43. Pod 8–20 mm. long, 4–9-ovulate; n.-e. California and n.-w. Nevada ..... *A. Pulsiferae* (p. 968)

43. Pod ± 4 mm. long, 2–3-ovulate; n. Harney County, Oregon ..... *A. tegetarioides* (p. 395)

4. Stipules all free (44)

44. Leaflet 1, subsessile, suborbicular, 1.5–4.5 cm long. Caulescent plants with erect, stipitate, inflated but firmly papery pods ..... *A. asclepiadoides* (p. 569)

44. Leaflet more than 1 (or if only 1 then much smaller and long-petioled) (45)

45. Pubescence of the leaves dolabriform (46)

46. Plants acaulescent or nearly so, the stems shorter than the longest leaves or inflorescences; *flowers* ascending, mostly subumbellate or shortly racemose; *pod* ascending, humistrate, deciduous; *leaflets* 1–13 (47)

47. Wing-petals deeply cleft at apex into divaricate lobes; *pod* narrowly oblong, compressed-triquetrous, fully bilocular ..... *A. calycosus* (p. 1082)
47. Wing-petals entire; *pod* ± obcompressed, unilocular ..... Subsect. *Missourienses* (p. 696)
46. Plants strongly caulescent, the stems much longer than leaves or inflorescences; *flowers* nodding, loosely racemose; *pod* erect, persistent, narrowly oblong, grooved dorsally, fully bilocular ..... *A. terminalis* (p. 524)
45. Pubescence basifixed (48)
48. Plants sparsely leafy, rushlike, the upper leaves reduced to the naked, filiform (sometimes apically dilated and hooked) rachis; *pod* deflexed or pendulous, stipitate or sessile, dorsiventrally or laterally compressed ..... Sect. *Lonchocarpi* (p. 252)
48. Plants sparsely to densely leafy, but leaflets present in all leaves, even though sometimes few, or distant, or confluent with the rachis (49)
49. Pod stipitate, the stipe sometimes short but always longer than its diameter (50)
50. Pod either laterally compressed and two-sided, or terete, in either case unilocular (51)
51. Pod slenderly fusiform, terete ..... *A. pinonis* (p. 259)
51. Pod laterally compressed, two-sided, bicarinate by both sutures (52)
52. Flower very small, the subsymmetrically campanulate tube of the calyx 2–4 mm., the banner 6.5–10 mm. long ..... Sect. *Solitarii* (p. 293)
52. Flower large, the broadly and deeply campanulate or subcylindric calyx-tube dorsally gibbous or very obliquely truncate at base, 5.5–12 mm. long, the banner 13.5–21 mm. long (53)
53. Stems from a determinate root-crown; *flowers* whitish, ochroleucous, or yellow; *body* of the pod (incurved, hooked, or coiled) leathery or stiffly papery ..... Sect. *Collini* (p. 300)
53. Stems from widely creeping, cordlike rhizomes; *flowers* purple; *body* of the pod (coiled or annular) papery; local in s.-w. Idaho ..... *A. camptopus* (p. 299)
50. Pod ± triquetrously or dorsiventrally compressed, dorsiventrally so if subunilocular, otherwise fully bilocular, rarely compressed laterally when ripe but then fully bilocular (54)
54. Leaves and stems hirsute with long, minutely bulbous-based hairs up to 1 mm. long and more. Stout, erect plants with large, nodding flowers, white petals, and body of the pendulous, glabrous pod linear-oblong in profile, triquetrous, grooved dorsally ..... *A. Drummondii* (p. 490)
54. Leaves and stems strigulose, or if hirsute the flowers purple and the pod also hirsute (55)
55. Pod declined or pendulous (56)
56. Body of the pod somewhat decurved, the prominent ventral suture convexly arched (sometimes only slightly so), the dorsal face grooved or excavated, the short beak declined; *wings* equaling or longer than the banner, the blades dilated distally ..... *A. atratus* (p. 470)
56. Body of the pod straight or incurved, the ventral suture never convexly arched; *wings* shorter than the banner, not or scarcely dilated distally (57)
57. Flower large, the cylindric calyx-tube 4.7–9 mm., the banner 13.5–21 mm. long; *body* of the pod 18–45 mm. long, 4.5–8 mm. in diameter ..... Sect. *Malaci* (p. 493)
57. Flower small, the campanulate calyx-tube 2–3.3 mm., the banner 5.5–8.5 mm. long; *body* of the pod 7–25 mm. long, 2.2–4.5 mm. in diameter ..... Sect. *Miselli* (p. 438)
55. Pod erect, or ascending and humistrate (58)
58. Pod erect or incurved to erect on an incurved *stipe* 6–15 mm. long, the body glabrous, grooved dorsally; *stems* and peduncles erect and ascending ..... *A. eremiticus* (p. 532)
58. Pod mostly humistrate from decumbent stems and procumbent peduncles, if erect subterete becoming laterally flattened;

stipe 0.5–2.5 mm. long ..... Sect. *Malaci* (p. 493)

49. Pod sessile (sometimes raised on a stipelike gynophore) or nearly so, the stipe, if present, not over 1 mm. long and no longer than its diameter (59)

59. Gynophore present, 1.5–12 mm. long; *flower* large, the calyx-tube 3.5–10 mm., the banner 16–26 mm. long. Pod either greatly inflated and unilocular, or dorsiventrally compressed and subunilocular ..... Sect. *Megacarpi* (p. 770)

59. Gynophore none (if the receptacle at all elevated the flower very much smaller) (60)

60. Pod greatly inflated, papery or papery-membranous, uni- or bilocular (61)

61. Pod bilocular ..... *A. lentiginosus* (p. 911)

61. Pod unilocular (62)

62. and readily deciduous from the receptacle ..... Sect. *Inflati* (p. 825)

62. and continuous with the receptacle, dehiscent on the raceme ..... *A. Preussii* var. *laxiflorus* (p. 576)

60. Pod not inflated, if somewhat turgid the valves fleshy becoming leathery or woody (63)

63. Flower small, the banner not over 12 mm., the calyx-tube not over 4.5 mm. long (64)

64. Racemes 2–3 together (or paired with a branchlet) in the same leaf-axil; *pod* very small, oblong, triquetrous, grooved dorsally, bilocular; mesophytes of alkaline lake shores and stream banks ..... *A. Lemmoni* (p. 1109)

64. Racemes solitary; *pod* larger; xerophytes (65)

65. Pod erect, straight, compressed-triquetrous, fully bilocular; *petals* subequal, the keel-tip sharply triangular ..... *A. obscurus* (539)

65. Pod either ascending (humistrate) or declined, always the latter if straight and then terete, if ascending variably compressed but always incurved, lunate or hamate, and uni- to semibilocular (66)

66. Stems erect (supported by sagebrush); *leaflets* linear or narrowly oblanceolate; *pod* declined, straight or nearly so, terete ..... *A. pinonis* (p. 259)

66. Stems prostrate or diffuse; *leaflets* of a broader type; *pod* lunately or hamately incurved, dorsiventrally or trigonously compressed ..... Sect. *Diphysi* (p. 910)

63. Flower larger, the banner 12–26 mm., or the calyx-tube 4.5 mm. long or more, or (commonly) both (67)

67. Acaulescent (or very shortly caulescent) plants, the proper stems shorter than the longest leaves or inflorescences (this including the peduncle and raceme-axis) (68)

68. Leaves, stems, and pods very densely and loosely pubescent, the leaves bearing many straight, spreading, spirally twisted villi; *pod* bilocular ..... *A. mollissimus* var. *Thompsonae* (p. 746)

68. Leaves, stems and pods variably pubescent, sometimes densely so, but no spirally twisted villi; *pod* unilocular ..... Sect. *Argophylli* (p. 622)

67. Strongly caulescent plants (69)

69. Leaflets linear, or linear-elliptic to linear-lanceolate, often remote (70)

70. Pod erect, broadly oblong or ovate-oblong, persistent on the receptacle ..... *A. Serenoi* (p. 545)

70. Pod declined or deflexed, ± dorsiventrally compressed or tetragonal, sometimes winged laterally or both laterally and along the sutures, readily deciduous ..... Sect. *Pterocarpi* (p. 787)

69. Leaflets of a broader type (71)

71. Stems and pods erect (72)

72. Pod 13–18 mm. long, 5–6 mm. in diameter, 14–18-ovulate; s. Idaho and adjoining Utah ..... *A. adanus* (p. 521)

72. Pod 20–40 mm. long, 10–15 mm. in diameter, 40–75-ovulate; s.-e. Nevada and adjoining Utah, s.- and e.-ward ..... *A. praelongus* (p. 584)

71. Stems diffuse or prostrate, the pods humistrately ascending from procumbent peduncles (73)

73. Leaves densely silvery- or cottony-pubescent ..... Sect. *Argophylli* (p. 622)

73. Leaves thinly pubescent, green or greenish (74)

74. Pod deciduous from an obconic receptacle, nearly always incurved through ½-circle or abruptly hooked or even annular; *lower stipules* small and inconspicuous ..... *A. iodanthus* (p. 958)

74. Pod continuous with the receptacle (commonly short-stipitate), persistent or deciduous with the pedicel, straight or incurved through ⅓-circle; *lower stipules* large, broad, ovate or obovate, obtuse and veiny, very conspicuous ..... *A. cibarius* (p. 495)

Regional Key VII. The Colorado Basin (Utah e. of the Wasatch, parts of w. Colorado, Arizona n. of the Mogollon pine forests and w. to the Kaibab Plateau, the San Juan Valley in n.-w. New Mexico, and the Green River Valley in w. Wyoming)

1. Leaflets 5–9, linear-elliptic, acute at both ends, all continuous with the rachis, mucronate or spinulose at apex, becoming rigid and prickly; *flowers* few (1–3), very small, the racemes shortly pedunculate or sessile in the leaf-axils; prostrate and matted or more erect and bushy-branched perennials, sometimes flowering the first season as diminutive seedlings ..... *A. Kentrophyta* (p. 357)

1. Leaflets more numerous, or jointed to the rachis, or if continuous with the rachis then the flowers more numerous, larger, and long-pedunculate (2)

2. Annual plants with small flowers, the banner not over 10 mm. long (3)

3. Pod linear in profile, trigonous, bilocular ..... Sect. *Leptocarpi* (p. 1008)

3. Pod ovoid or ovoid-ellipsoid (4)

4. Pod obliquely ovoid or half-ovoid, usually bladdery, truly unilocular (if a very narrow septum present the valves papery-membranous) ..... Sect. *Inflati* (p. 825)

4. Pod ovoid-ellipsoid, scarcely inflated, slightly decurved, semibilocular; cf. seedling plants of normally perennial ..... *A. Brandegei* (p. 479)

2. Perennial plants, if monocarpic, or flowering early in the year from seed and appearing annual, then the flowers much larger (5)

5. Pubescence of the leaves dolabriform (6)

6. Terminal leaflet of at least some upper leaves continuous with the rachis (the upper leaves often reduced to the subfiliform rachis); *plants* strongly caulescent (7)

7. Stems slender, decumbent, arising singly or few together from extremely slender, subterranean caudex-branches; *stipules* connate; *pod* pendulous, stipitate, ± bladdery, the valves papery-membranous ..... *A. ceramicus* (p. 338)

7. Stems stout, ascending, arising together in a clump from the subterranean root-crown or caudex; *stipules* very large, foliaceous, not connate; *pod* erect, sessile, narrowly oblong, two-sided, the valves stiffly papery ..... *A. Woodruffi* (p. 436)

6. Terminal leaflets all jointed, the leaves all imparipinnate, or all trifoliolate, or if some simple then plant acaulescent (8)

8. Stipules all, or at least those at the lowest 1–3 nodes, connate (9)

9. Plants strictly acaulescent, tufted, matted, or mounded (10)

10. Leaves all trifoliolate; *stipules* very large, hyaline, united both opposite and behind the petiole (10a)

10a. Flower long and narrow, the cylindric calyx-tube 6–16 mm. long; *banner* nearly erect, narrowly oblanceolate or narrowly panduriform, 12.5–28 mm. long; *flowers* sessile or nearly so in the axils of leaf-rosettes ..... Sect. *Orophaca* (p. 1150)

10a. Flower much shorter, the campanulate calyx-tube less than 3 mm., the obovate-cuneate, recurved banner not over 8 mm.

long; *flowers* usually short-pedunculate ..... *A. aretioides* (p. 1146)

10. Leaves all, or at least a few of the lowest ones, reduced to a narrowly oblanceolate or spatulate phyllode; *stipules* united opposite the petiole only, not very large, scarious but not hyaline ..... Sect. *Drabellae* (p. 282)

9. Plants caulescent (11)

11. Stems arising singly or few together from slender rhizomes; *pod* erect, oblong-cylindroid or trigonous, straight or incurved, bilocular ..... Sect. *Uliginosi* (p. 597)

11. Stems arising together from a superficial root-crown or caudex; *pod* variously oriented, but unilocular (12)

12. Pod linear-oblanceolate or exactly linear in profile, laterally compressed, two-sided ..... *A. miser* (p. 231)

12. Pod ovoid or lance-ellipsoid, ± obcompressed proximally (13)

13. Pod pendulous, stipitate; *stems* tall, mostly 2.5–7 dm. long, erect, freely branching upward; *plants* flowering in summer and fall ..... *A. albulus* (p. 405)

13. Pod ascending or erect, sessile; *stems* shorter if erect and simple above the base, or if as tall and branched upward then prostrate; *plants* flowering in spring (14)

14. Stems erect or ascending, not matted; *pod* bisulcate ventrally, the ventral keel depressed and lying in a double groove ..... Sect. *Ocreati* (p. 397)

14. Stems diffuse or prostrate, sometimes matted; *pod* dorsiventrally compressed but the ventral keel prominent, not depressed and lying in a double groove ..... Sect. *Humistrati* (p. 382)

8. Stipules all free (even though fully amplexicaul). Acaulescent and shortly caulescent plants (15)

15. Wing-petals deeply cleft at apex; truly acaulescent plants with scapiform peduncles and oblong, compressed-triquetrous, fully bilocular pods ..... *A. calycosus* (p. 1082)

15. Wing-petals entire or obscurely emarginate; *pod* either unilocular or bilocular, but if the latter subglobose (16)

16. Pulvinately matted or densely tufted and erinaceous plants of rimrock pavement at Grand Canyon, Arizona, and Mesa Verde, Colorado, with tiny leaves and flowers and very small, plumply ovoid pods 3–4.5 mm. long; *ovules* 4–6 ..... Sect. *Humillimi* (p. 1000)

16. Loosely tufted plants with much larger flowers and many-ovulate pods ..... Sect. *Argophylli* (p. 622)

5. Pubescence basifixed (17)

17. Leaves all reduced to a subsessile, suborbicular, leathery, glaucescent blade 1.5–4.5 cm. long. Coarse, caulescent plants with erect, narrow flowers and erect, stipitate, inflated but stiff-walled pods ..... *A. asclepiadoides* (p. 569)

17. Leaves pinnate, or if reduced to a simple blade this linear-filiform or grasslike (18)

18. Stipules, at least at the lowest 1–3 nodes, connate into a bidentate sheath (19)

19. Leaflets all, or at least the terminal leaflet of some upper leaves, continuous with the rachis (20)

20. Flower small, the campanulate calyx-tube 2–5 mm., the banner 7–11 mm. long; *pod* laterally compressed, two-sided, unilocular (21)

21. Pod linear or linear-oblanceolate 12–50 mm. long ..... Sect. *Genistoidei* (p. 230)

21. Pod ellipsoid or half-ellipsoid, 9–15 mm. long ..... *A. wingatanus* (p. 215)

20. Flower much larger, the banner 14.5–30 mm. long (22)

22. Calyx not inflated, strigulose, the fruit well exserted, bicarinate by thickened, salient sutures ..... Sect. *Pectinati* (p. 423)

22. Calyx inflated, densely silky-pilose, enclosing the small, ventrally bisulcate fruit. Coarse plants of the upper San Juan Valley, nearly glabrous below the densely spicate or headlike, silky-pilose inflorescence ..... *A. oocalycis* (p. 419)

19. Leaves all regularly pinnate, the terminal and lateral leaflets all jointed (23)

23. Stems and leaves hirsute. Coarse plants with large, nodding, white flowers and pendulous, stipitate pods, the body linear, triquetrous, glabrous, bilocular ..... *A. Drummondii* (p. 490)
23. Stems and leaves glabrous, strigulose, or villosulous; *pod* not as above in some respects (24)
24. Flower small, the calyx-tube less than 4 mm., the banner less than 13 mm. long (25)
25. Pod sessile, greatly inflated, fully bilocular, subglobose, papery; *style* exserted shortly from the narrowly triangular keel-tip; low cryptophytes of sandy talus along the Zion Escarpment in Utah ..... *A. striatiflorus* (p. 973)
25. Pod inflated or not, but if so then unilocular; *style* included (26)
26. Pod both sessile and bladdery-inflated (27)
27. Stems 1–7 dm. long (28)
28. Pod 12–32 mm. long, 12–32-ovulate, continuous with the receptacle, deciduous with the pedicel; xerophytes (of dunes, dry pine forest, etc.) ..... Sect. *Scytocarpi* (p. 199)
28. Pod 6–12 mm. long, 5–9-ovulate, deciduous from the receptacle; mesophytes (of moist rushy meadows and stream banks), rare with us (Wayne County) ..... *A. Bodini* (p. 371)
27. Stems 0–7 cm. long (29)
29. Caudex aerial; *ovules* 10–14 ..... Sect. *Jejuni* (p. 379)
29. Root-crown subterranean; *ovules* ± 20 ..... *A. Perianus* (p. 972)
26. Pod not inflated, either sessile or stipitate (30)
30. Pod linear, linear-oblanceolate, or narrowly elliptic in profile laterally compressed, two-sided, bicarinate by the sutures (31)
31. Root-crown or caudex aerial (32)
32. Pod stipitate, turning black when dry ..... *A. tenellus* (p. 344)
32. Pod sessile, not blackening ..... *A. miser* (p. 231)
31. Root-crown or caudex (and base of the stems) subterranean ..... *A. wingatanus* (p. 215)
30. Pod various in outline, but terete, or dorsiventrally or trigonously compressed (33)
33. Plants (of Mesa Verde, Colorado) acaulescent or nearly so; *pod* deciduous from a short gynophore, trigonously compressed, grooved dorsally ..... *A. deterior* (p. 724)
33. Plants (of other range) caulescent; *pod* either truly sessile or stipitate, never grooved dorsally (34)
34. Pod nearly always erect, sessile, bisulcate ventrally; *leaflets* mostly linear; *stems* shorter than the inflorescences ..... *A. moencoppensis* (p. 403)
34. Pod deflexed or pendulous, if bisulcate ventrally then stipitate, and the leaflets of a broader type; *stems* longer than the inflorescences (35)
35. Pod terete or simply compressed dorsiventrally, the ventral suture not depressed and lying in a double groove, the valves not transversely corrugated ..... Sect. *Scytocarpi* (p. 199)
35. Pod (stipitate) dorsiventrally compressed, the dorsal suture depressed and lying in a double groove, the valves transversely corrugated ..... *A. bisulcatus* var. *Haydenianus* (p. 413)
24. Flower larger, the calyx-tube over 4 mm., the banner over 13.5 mm. long (36)
36. Calyx-tube campanulate; *pod* pendulous, stipitate, unilocular ..... Sect. *Bisulcati* (p. 407)
36. Calyx-tube cylindric or subcylindric; *pod* stipitate, but either erect or bilocular (37)
37. Flowers crowded into ovoid heads; *pod* shortly stipitiate, ± invested by the calyx, the body small, trigonously com-

pressed, hirsute, bilocular ..... *A. agrestis* (p. 618)
37. Flowers loosely racemose; *pod* exserted far beyond the calyx on an elongate stipe, the body not hirsute (38)
38. Body of the pendulous pod narrowly oblong, compressed-triquetrous, grooved dorsally, bilocular; *flowers* nodding ..... *A. scopulorum* (p. 198)
38. Body of the erect pod plumply ovoid, inflated, uni- or subunilocular; *flowers* ascending ..... *A. ampullarius* (p. 568)
18. Stipules all free (39)
39. Leaflets, at least the terminal one of some leaves, often all, continuous with the rachis (40)
40. Pod thickly fleshy becoming sharply tetragonal, with 4 keels and 4 subequal, shallowly concave faces ..... *A. tetrapterus* (p. 792)
40. Pod thinly or not at all fleshy, variously compressed to terete but never tetragonal, the valves papery or thinly leathery (41)
41. Lowest stipules very large, 1–2.5 cm. long, united into a sheath behind the suppressed petiole; *pod* erect or incurved-ascending, sessile, laterally compressed, 2-sided, bicarinate by the sutures ..... *A. Woodruffi* (p. 436)
41. Lowest stipules much smaller; *pod* pendulous, if two-sided then stipitate (42)
42. Pod (stipitate) inflated ..... *A. Eastwoodae* (p. 577)
42. Pod (stipitate or sessile) not inflated ..... Sect. *Lonchocarpi* (p. 252)
39. Leaflets all jointed in all leaves (43)
43. Flower small, the banner 12 mm. long or less (44)
44. Plants strictly acaulescent; *flowers* and small, subglobose pods crowded into ovoid or oblong heads on scapose peduncles ± equaling the leaves; Flagstaff Plateau, Arizona, and vicinity ..... *A. troglodytus* (p. 1001)
44. Plants caulescent, or if subacaulescent the flowers loosely racemose, the pods not subglobose, and range different (45)
45. Peduncles (very slender or subfiliform) dimorphic, the early ones subradical, 1-flowered, the later ones elongate and remotely 2–7-flowered; *pod* deflexed, slightly arched downward, inversely boat-shaped, semibilocular ..... *A. Brandegei* (p. 479)
45. Peduncles homomorphic, none subradical (or if so the pod quite otherwise); *pod* either ascending (humistrate), or unilocular (exceptionally subunilocular) or strongly incurved (46)
46. Stems from a subterranean root-crown or caudex; *pod* declined or pendulous, linear or narrowly oblong in profile, uni- or exceptionally subunilocular ..... Sect. *Lonchocarpi* (p. 252)
46. Stems from a superficial root-crown or caudex; *pod* usually ascending and humistrate, always so if narrowly oblong, uni- or bilocular (47)
47. Plants strongly caulescent, the stems much longer than the peduncles (47a)
47a. Pod uni- or subunilocular ..... Sect. *Inflati* (p. 825)
47a. Pod bilocular ..... Sect. *Diphysi* (p. 910)
47. Plants subacaulescent, the stems shorter than the peduncles ..... Sect. *Desperati* (p. 720)
43. Flower larger, the banner 12.5–28 mm. long (48)
48. Plants subacaulescent or truly acaulescent, the proper stems not longer than the longest leaves and inflorescences (49)
49. Leaves very densely hirsute-tomentose, the longer hairs straight and spirally twisted; *pod* fully bilocular ..... *A. mollissimus* (p. 733)
49. Leaves variably pubescent to subglabrous, but if densely tomentose the hairs all extremely fine, sinuous and cottony, none straight and spirally twisted (50)
50. Pod bladdery-inflated, papery, unilocular (51)
51. Pod 1–2 cm. long, hirsute ..... *A. desperatus* var. *conspectus* (p. 729)
51. Pod 2.5–6 cm. long, strigulose or subglabrous ..... Sect. *Megacarpi* (p. 770)
50. Pod not inflated, or if somewhat so then the valves leathery

or pithy, never bladdery ..... Sect. *Argophylli* (p. 622)
48. Plants strongly caulescent, the peduncles much shorter than the stems and obviously lateral (52)
52. Pod papery, bladdery-inflated, unilocular, sessile or elevated on a stipelike gynophore (53)
53. Stems from a buried root-crown; *leaflets* 15–27, closely crowded together and folded; local on shale barrens of the Uinta Basin ..... *A. lutosus* (p. 785)
53. Stems from a superficial root-crown or caudex; *leaflets* fewer, well spaced.—Return to choice 51/51
52. Pod not inflated, or if so either truly stipitate, or bilocular (54)
54. Pod (sessile, unilocular) when ripe sharply 4-angled and 4-sided; *stems* from a buried root-crown ..... *A. tetrapterus* (p. 792)
54. Pod not 4-angled; *stems* mostly from a superficial root-crown, if from a buried one then the pod either stipitate or bilocular (55)
55. Pod stipitate, the stipe at least 2 mm. long (56)
56. Leaves and stems hirsute ..... *A. Drummondii* (p. 490)
56. Leaves and stems strigulose (sometimes loosely) to subglabrous (57)
57. Pod erect or ascending (humistrate), never pendulous (58)
58. Stems erect and ascending; *pod* erect, subterete or trigonous, never flattened and 2-sided (59)
59. Body of the pod trigonously compressed, grooved dorsally, bilocular or nearly so ..... *A. eremiticus* (p. 532)
59. Body of the pod terete or nearly so, uni- or subunilocular ..... Sect. *Preussiani* (p. 573)
58. Stems procumbent, diffuse; *pod* ascending but humistrate, the (bilocular) body laterally compressed, 2-sided, bicarinate by the sutures ..... *A. malacoides* (p. 500)
57. Pod pendulous (60)
60. Body of the pod linear or linear-oblanceolate in profile, not at all inflated (either laterally or dorsiventrally compressed ..... Subsect. *Lonchocarpi* (p. 252)
60. Body of the pod plumply ovoid or subglobose, greatly inflated (not or slightly dorsiventrally compressed) ..... *A. Eastwoodae* (p. 577)
55. Pod sessile or subsessile, the stipe (if present) less than 2 mm. long (61)
61. Pod broadly ovoid or subglobose, inflated, fully bilocular (62)
62. Valves of the pod thin-textured, papery or stiffly papery but much less than 1 mm. thick when dry ..... *A. lentiginosus* (p. 911)
62. Valves of the pod thick-textured, fleshy, becoming at least 1 mm. thick and pithy when dry ..... *A. crassicarpus* var. *cavus* (p. 759)
61. Pod narrowly elliptic, lanceolate, linear-oblong, or oblong in outline, not inflated, or if broadly ovoid to subglobose then unilocular or nearly so (63)
63. Pod subunilocular, the septum narrow, often obscure, traversing less than half the width of the cavity (64)
64. Lower stipules crowded at base of the stem, ± imbricated, broadly obovate and obtuse, several-nerved; *pod* humistrately ascending from procumbent peduncles ..... *A. ensiformis* (p. 498)
64. Lower stipules not as above; *pod* either deflexed or ascending, but if ascending then erect from erect peduncles ..... Sect. *Preussiani* (p. 573)
63. Pod fully bilocular, the septum complete (or nearly

so, traversing well over half the cavity) (65)
65. Pod either triquetrous or terete, carinate by the ventral suture only, or by neither (66)
66. Pod persistent on the receptacle ..... *A. mokiacensis* (p. 580)
66. Pod readily deciduous (67)
67. Pod sharply compressed-triquetrous, grooved dorsally; plants of the Colorado canyons from Glen Canyon to Grand Canyon ..... *A. Bryantii* (p. 1014)
67. Pod commonly subterete, rarely sulcate dorsally, if so the angles all plumply rounded (normally sulcate along both sutures) ..... *A. lentiginosus* var. *palans* (p. 955)
65. Pod terete when first formed becoming when dry laterally compressed and two-sided, bicarinate by the salient sutures (extreme n.-w. Arizona, very local) ..... *A. ensiformis* (p. 498)

Regional Key VIII. Mohave and Colorado Deserts

1. Annual plants with small flowers, the keel not over 8 mm. long; *racemes* not over 10-flowered, nor over 3 cm. long in fruit (2)
2. Pod less than 5 mm. long, ovoid or subglobose, transversely rugulose, bilocular, 2-seeded ..... *A. didymocarpus* (p. 1133)
2. Pod larger or longer, either narrow and elongate, or turgid and inflated, several-seeded (3)
3. Pod turgid or greatly inflated, obliquely ovoid to subglobose, unilocular, the valves papery or papery-membranous ..... Sect. *Inflati* (p. 825)
3. Pod linear or oblong in profile, not inflated, 2- or 3-sided, commonly trigonous, fully or semibilocular, if broader than linear-oblong then the valves fleshy becoming stiffly papery or leathery ..... Sect. *Leptocarpi* (p. 1008)
1. Perennial plants, if short lived, or flowering the first year, or monocarpic, then the flowers larger, the keel 9 mm. long or more, or the racemes loosely many-flowered (4)
4. Vesture of the leaves dolabriform (5)
5. Acaulescent or low and tufted subacaulescent plants with free stipules (6)
6. Truly acaulescent, the peduncles scapose; *wing-petals* bidentate; *pod* oblong, compressed-triquetrous, fully bilocular ..... *A. calycosus* (p. 1082)
6. Subacaulescent, the peduncles subradical but clearly axillary; *wing-petals* entire; *pod* obliquely ellipsoid, crescentic, laterally compressed at both ends, obcompressed at the middle, unilocular ..... Subsect. *Missourienses* (p. 696)
5. Caulescent, matted plants with connate stipules, axillary peduncles, entire wing-petals, and obliquely ovoid, unilocular pods ..... *A. humistratus* (p. 383)
4. Vesture of the leaves basifixed (7)
7. Stipules, at least at the lowest nodes, connate (8)
8. Pod (stipitate or sessile) bladdery-inflated, plumply ovoid or balloon-shaped (9)
9. Plants caulescent; *pod* stipitate, unilocular ..... *A. Whitneyi* (p. 329)
9. Plants acaulescent or nearly so; *pod* sessile, fully bilocular ..... *A. platytropis* (p. 979)
8. Pod (sessile) not inflated (10)
10. Herbage strigulose; *pod* fleshy becoming leathery, ± dorsiventrally compressed, strigulose, unilocular ..... *A. Casei* (p. 788)
10. Herbage silky-villosulous; *pod* thin-textured, becoming papery, compressed-triquetrous, villosulous, bilocular ..... *A. sepultipes* (p. 1117)
7. Stipules all free (11)
11. Pubescence of the herbage, and of the stems when developed, hirsute, villous, villosulous, or tomentulose, the hairs curly or incumbent, or when straight spreading at a wide angle, or some of them so (12)
12. Flower small, the banner not over 8 mm., the keel not over 6.5 mm. long; *pod* inflated ..... Sect. *Inflati* (p. 825)
12. Flowers larger (13)
13. Plants truly acaulescent, subacaulescent, or shortly caulescent, tufted

or matted, with superficial root-crown or caudex, the stems when developed shorter than the longest leaves; *pod* uni- or subunilocular ..... Sect. *Argophylli* (p. 622)

13. Plants strongly caulescent, or if apparently only shortly so (as in *A. Layneae*), the stems arising singly or few together from horizontal rhizomes; *pod* bilocular (14)
14. Pod firm, not inflated, villosulous or hirsute (15)
15. Stems arising together from the superficial root-crown; *pod* erect or narrowly ascending, oblong, straight, slightly compressed laterally, abruptly contracted at apex, densely and softly long-villous, 1.2–2.3 cm. long ..... *A. Minthorniae* (p. 501)
15. Stems arising singly or few together from buds on slender, horizontal rhizomes; *pod* incurved-ascending or declined, crescentic or almost annular, obcompressed or triquetrous at the middle, long-acuminate distally, hirsutulous, 3–6 cm. long ..... *A. Layneae* (p. 730)
14. Pod inflated, or if not inflated then papery and silky-strigulose ..... *A. lentiginosus* (p. 911)

11. Pubescence of appressed or subappressed hairs, the hairs usually straight, rarely wavy, sometimes almost lacking (16)
16. Calyx-tube cylindric, 6–13.5 mm. long, pubescent even though thinly so (17)
17. Plants acaulescent or nearly so, the stipules imbricated ..... Sect. *Argophylli* (p. 622)
17. Plants strongly caulescent, some internodes well developed (18)
18. Leaflets obovate-cuneate, obtuse or retuse; *pod* turgid or inflated, stiffly papery ..... Sect. *Preussiani* (p. 573)
18. Leaflets linear-oblong or narrowly elliptic, acute or obtuse; *pod* not or little inflated, the valves in any case fleshy becoming leathery or subligneous (19)
19. Pod erect, persistent, broadly oblong in profile, subterete, 1.7–3 cm. long, abruptly cuspidate at apex, glabrous; *leaflets* mostly acute ..... *A. Serenoi* (p. 545)
19. Pod declined or deflexed, readily deciduous, narrowly oblong-ellipsoid, obcompressed in the lower ⅔, acuminate distally into a laterally compressed beak, 2–5.5 cm. long, strigulose; leaflets obtuse ..... *A. Casei* (p. 788)
16. Calyx-tube campanulate, sometimes deeply so, but not over 6 mm. long, or if up to 6.5 mm. long then glabrous (20)
20. Pod sessile on the receptacle or on a stipelike gynophore, bladdery-inflated, the valves papery or papery-membranous (21)
21. Pod elevated on a stipelike gynophore, the body subsymmetrically ellipsoid ..... *A. oophorus* (p. 775)
21. Pod sessile on the receptacle (sometimes borne on a short gynophore in *A. nutans*, but the body then obliquely ovoid with incurved beak) (22)
22. Stems from a subterranean root-crown; *pod* persistent on the receptacle; Charleston Mountains, Nevada ..... *A. aequalis* (p. 261)
22. Stems from a superficial root-crown or caudex; *pod* deciduous; widespread (including the Charlestons) (23)
23. Petals subequal; subacaulescent plants of high elevations in the Inyo and Charleston Mountains ..... *A. platytropis* (p. 979)
23. Petals graduated, the keel much shorter than the banner; widespread, caulescent plants (23a)
23a. Pod unilocular ..... Sect. *Inflati* (p. 825)
23a. Pod bilocular ..... Sect. *Diphysi* (p. 910)
20. Pod either sessile or stipitate, but not bladdery-inflated (or if rarely bladdery then also stipitate) (24)
24. Pod stipitate (25)
25. Body of the pod becoming laterally compressed, bicarinate by the salient sutures (26)
26. Pod incurved-ascending; *flowers* large, the banner 15–22 mm. long, the keel-tip obtuse; *stems* from a superficial caudex ..... *A. pachypus* (p. 487)

26. Pod pendulous; *flowers* small, the banner 7–10 mm. long, the keel-tip triangular; *stems* from a buried root-crown ..... *A. Jaegerianus* (p. 485)
25. Body of the pod either triquetrous or obcompressed, either flattened or sulcate dorsally or ventrally (27)
27. Body of the pod triquetrous, grooved dorsally; *stems* mostly erect or ascending in clumps ..... Sect. *Reventi-arrecti* (p. 515)
27. Body of the pod ± dorsiventrally compressed, flattened or sulcate at the middle ventrally; *stems* diffuse (28)
28. Foliage glabrous or nearly so, glaucescent; *flowers* relatively large, the banner over 12 mm. long; *pod* glabrous ..... *A. cimae* (p. 505)
28. Foliage strigulose, not glaucescent; *flowers* small, the banner 8.5–10.5 mm. long; *pod* strigulose ..... *A. inyoensis* (p. 483)
24. Pod sessile (sometimes elevated on a gynophore) (29)
29. Raceme 1–4-flowered; *stems* and caudex branches very slender, beset with wiry, persistent petioles ..... *A. panamintensis* (p. 999)
29. Raceme at least 5-flowered; *petioles* not persistent (30)
30. Pod glabrous, exactly triquetrous, elevated on a short, stipelike gynophore ..... Subsect. *Tricarinati* (p. 1029)
30. Pod pubescent, variably compressed but not equally 3-sided, sessile (31)
31. Leaflets green and glabrescent above, the foliage gray but not silvery-silky; *pod* laterally compressed, 2-sided ..... *A. atratus* var. *mensanus* (p. 473)
31. Leaflets densely silvery-silky on both sides (32)
32. Leaflets 5–11; *pod* commonly declined, variably compressed but not subterete ..... Subsect. *Mohavenses* (p. 1020)
32. Leaflets more numerous; *pod* ascending, subterete ..... *A. lentiginosus* var. *borreganus* (p. 953)

Regional Key IX. Central and southern Arizona, New Mexico (excluding some northwestern sectors), and trans-Pecos Texas

1. Leaflets 5–9, linear-elliptic, acute at both ends, all continuous with the rachis, mucronate or spinulose at apex; becoming rigid and prickly; *flowers* few (1–3), very small, the racemes shortly pedunculate or sessile in the leaf-axils; prostrate and matted or more erect and bushy-branched perennials, sometimes flowering the first season as diminutive seedlings ..... *A. Kentrophyta* (p. 357)
1. Leaflets more numerous, or jointed to the rachis, or if continuous with the rachis then the flowers more numerous, larger, and the racemes long-pedunculate (2)
2. Annual plants (3)
3. Pod very small, not over 5 mm. long, subglobose, divided by a deep dorsal groove into two saclike, 1-seeded, transversely rugulose lobes ..... *A. didymocarpus* (p. 1133)
3. Pod larger or longer, several- or many-seeded (4)
4. Pod lance-oblong or linear in profile, straight or incurved, triquetrous or compressed-triquetrous, fully bilocular ..... Sect. *Leptocarpi* (p. 1008)
4. Pod obliquely ovoid or subglobose, inflated, unilocular ..... Sect. *Inflati* (p. 825)
2. Perennial plants (if any doubt, follow this choice) (5)
5. Stipules all, or at least those at the lowest nodes, connate into a truncate or bidentate sheath (6)
6. Pubescence of the leaves dolabriform (7)
7. Terminal leaflet of all leaves linear, elongate, continuous with the rachis; *lateral leaflets* few, often reduced in size or number in the upper leaves, or absent; *stems* arising singly or few together from very slender, subterranean caudex-branches; *pod* pendulous, stipitate, ± inflated, mottled ..... *A. ceramicus* (p. 338)
7. Terminal leaflet of all leaves jointed; *stems* from a determinate root-crown or caudex (8)
8. Pod compressed-triquetrous, fully bilocular; *flowers* narrowly ascending and erect in ovoid or oblong heads; *banner* over 13 mm. long; entering n.-e. New Mexico ..... *A. adsurgens* var. *robustior* (p. 614)
8. Pod variably compressed, unilocular; *flowers* loosely racemose, ascending

or spreading; if from e. of the Pecos in New Mexico then the banner not over 12 mm. long (9)

9. Plants diffuse or prostrate; *petals* nearly always tinged or veined with pink, lilac, or purple; plants of yellow pine and piñon-juniper forest, not of sedimentary badlands, scentless ..... *A. humistratus* (p. 383)

9. Plants erect or ascending; *petals* whitish or pale yellow (the keel sometimes lavender-tipped); malodorous (selenium-scented) plants of sedimentary badlands (10)

10. Stems 2.5–7 dm. long, freely branched upward; *pod* pendulous, shortly stipitate; flowering and fruiting from July to October, after summer rains ..... *A. albulus* (p. 405)

10. Stems not over 2 dm. long, simple or sparingly branched at base; *pod* erect, sessile; flowering in early spring and in fruit soon afterward, April to July ..... *A. flavus* (p. 398)

6. Pubescence basifixed (11)

11. Flowers large, the banner 12–26 mm., the keel 9–15.5 mm. long (12)

12. Flowers erect, in ovoid heads; *pod* small, not over 1 cm. long, ± invested by the persistent calyx, erect, shortly stipitate, bilocular, hirsute; plants of moist (but sometimes summer-dry) soils, entering n. New Mexico ..... *A. agrestis* (p. 618)

12. Flowers ascending, spreading, or declined, ± loosely racemose; *pod* pendulous if stipitate, sessile if ascending, in any case longer, well exserted, and if bilocular then pendulous, the valves glabrous, strigulose, or shortly villosulous; plants of dry soils (13)

13. Stems and herbage hirsute with spreading hairs at least 1 mm. long; *flowers* white; *pod* pendulous, stipitate, glabrous, bilocular ..... *A. Drummondii* (p. 490)

13. Stems and herbage subglabrous, strigulose, or villosulous, the hairs much less than 1 mm. long if spreading (or if a few as long then the flowers purple and the pod sessile); *pod* either pubescent, or unilocular, or both (14)

14. Stems arising together from a determinate root-crown at soil-level; stout, maladorous (selenium-scented) plants with erect and ascending stems; *body of the pod* 2.5–6 mm. in diameter, either triquetrous or dorsiventrally compressed, if the latter then 2-grooved ventrally, straight or nearly so, unilocular ..... Sect. *Bisulcati* (p. 407)

14. Stems arising from a deep-seated, subterranean root-crown situated (1) 2–20 cm. below soil-level; plants variable in stature, scentless or nearly so, with diffuse and ascending stems; *body of the pod* either subterete or a trifle obcompressed (never 2-grooved ventrally), or if triquetrous then bilocular (15)

15. Flowers ochroleucous; *pod* compressed-triquetrous, fully bilocular ..... *A. scopulorum* (p. 198)

15. Flowers purple or purplish, if pale the banner strongly purple-veined; *pod* either terete or dorsiventrally compressed, unilocular ..... Subsect. *Halliani* (p. 223)

11. Flowers small, the banner 6–11 mm., the keel 4–9 mm. long (16)

16. Plants extremely slender, diffusely branched, prostrate, matted, with tiny, villous leaves rarely over 1 cm. long, the leaflets subpalmate, 1–4 mm. long; *racemes* 1–3-flowered; *pod* 4–5 mm. long ..... *A. micromerius* (p. 394)

16. Plants taller, not matted, with more numerous or longer leaflets and several-flowered racemes (17)

17. Pod subuni- to semibilocular, but a septum always present even though narrow and obscure; *body of the pod* stipitate (except in *A. cobrensis*) and ± obcompressed or trigonous ..... Sect. *Strigulosi* (p. 146)

17. Pod strictly unilocular; *body of the pod* sessile when dorsiventrally or trigonously compressed, laterally compressed if stipitate (18)

18. Pod both stipitate and laterally compressed, the body like the lower stipules turning black on drying; *flowers* (with us) whitish ..... *A. tenellus* (p. 344)

18. Pod sessile (or nearly so), terete, or subtrigonous, or in one species laterally flattened, but the body then not blackening and the

petals ordinarily purple or purplish ..... Sect. *Scytocarpi* (p. 199)

5. Stipules all free, semi- or sometimes fully amplexicaul but not united opposite the petiole (19)
19. Pubescence of the leaves dolabriform (20)
20. Pod narrowly oblong, compressed-triquetrous, fully bilocular (21)
21. Plants acaulescent; *wing-petals* deeply 2-lobed at apex ..... *A. calycosus* (p. 1082)
21. Plants strongly caulescent; *wing-petals* entire or subemarginate ..... *A. arizonicus* (p. 1018)
20. Pod variable in shape but always unilocular, if narrowly oblong then terete becoming a little laterally flattened and bicarinate by the sutures (22)
22. Pod very small, 4.5–7.5 mm. long, 7–11-ovulate; either the plant pulvinate, or strictly acaulescent and tufted with scapiform peduncles and dense, headlike racemes of small flowers ..... Sect. *Humillimi* (p. 1000)
22. Pod larger, 9–37 mm. long; *ovules* at least 22; plants never pulvinate, seldom truly acaulescent (and the racemes then not headlike) (23)
23. Flowers large, pink-purple, the banner 14.5–24.5 mm. long ..... Subsect. *Missourienses* (p. 696)
23. Flowers smaller, the banner less than 14 mm., the keel less than 10 mm. long (24)
24. Pod obtuse at both ends, abruptly cuspidate at apex, long-persistent and dehiscent on the raceme; no cleistogamous flowers; Rio Grande Valley w.-ward ..... Subsect. *Missourienses* (p. 696)
24. Pod obtuse at base, acuminate at apex, readily deciduous when ripe; *flowers* often, especially in young plants and late in the season on older plants, minute, cleistogamous, borne on very short, subradical peduncles; Rio Grande e.-ward ..... *A. lotiflorus* (p. 994)

19. Pubescence basifixed (25)
25. Terminal leaflets, at least of some upper (often of all) leaves, continuous with the rachis. Sparsely leafy, junceous or ephedroid plants, with pendulous, stipitate, unilocular pods ..... Sect. *Lonchocarpi* (p. 252)
25. Terminal leaflets never decurrent, all leaves regularly pinnate (26)
26. Flowers small, the banner 4–12 mm., the keel 3.5–8.5 mm. long (27)
27. Plants strictly acaulescent, with imbricated stipules, scapiform peduncles, and dense, headlike racemes of small, reddish flowers and globose, ventrally carinate, unilocular pods ..... *A. troglodytus* (p. 1001)
27. Plants caulescent, with at least 1–2 visible internodes; inflorescence otherwise (28)
28. Peduncles filiform, dimorphic, the early ones subradical and shorter than the leaves, the upper ones surpassing the leaves and decumbent or prostrate; *racemes* remotely 1–7-flowered; *pod* pendulous, obovoid- or oblong-ellipsoid, 1–1.8 cm. long, obcompressed, flattened or openly sulcate dorsally, subbilocular ..... *A. Brandegei* (p. 479)
28. Peduncles often slender, but all alike; *pod* either unilocular and inflated, or bilocular and then linear or linear-lanceolate in profile (29)
29. Pod bladdery-inflated (or at least strongly turgid), unilocular ..... Sect. *Inflati* (p. 825)
29. Pod neither inflated nor turgid, linear or linear-lanceolate in profile, ± strongly incurved or nearly straight, triquetrously compressed, grooved dorsally, fully bilocular (30)
30. Flowers very numerous (15–50), very small, early nodding, disposed in narrowly oblong, early elongating and interrupted racemes; *pod* sharply deflexed; *plants* flowering in summer and fall ..... *A. vaccarum* (p. 1094)
30. Flowers relatively few, 1–25, if more than 15 then spreading or loosely ascending and the pod ascending; *plants* flowering principally in spring ..... Sect. *Leptocarpi* (p. 1008)

26. Flowers large, the banner (11.5) 12–32 mm., the keel (9) 10–26 mm. long (31)
31. Pod stipitate (32)
32. Pod pendulous; *stems* and herbage hirsute; *flowers* white. ..... *A. Drummondii* (p. 490)

32. Pod erect or incurved-ascending; *stems* and herbage strigulose; *flowers* purple ..... *A. eremiticus* (p. 532)
31. Pod sessile (33)
33. Herbage both tomentulose and pilose, with shorter curly and longer, spirally twisted hairs, the vesture commonly turning rusty when dry (34)
34. Plants tufted or acaulescent, the stems proper (when developed) not or scarcely longer than the longest leaves or inflorescences; *flowers* ascending at anthesis; *pod* ascending but humistrate, readily deciduous when ripe; *petals* purple or purplish except in one w.-centr. Texan form ..... *A. mollissimus* (p. 733)
34. Plants taller, strongly caulescent, the stems ± erect, the peduncles lateral and axillary; *flowers* nodding at anthesis; *pod* stiffly erect, persistent; *petals* ochroleucous; in Texas only in the Davis Mountains ..... *A. giganteus* (p. 750)
33. Herbage variably pubescent or glabrate, but the pubescence not as above (35)
35. Flowers nodding at full anthesis; *petals* ochroleucous or whitish, concolorous with the calyx-tube; coarse, malodorous, subglabrous plants of badlands and alkaline clay soils, with fleshy, subunilocular pods ..... *A. praelongus* (p. 584)
35. Flowers ascending at full anthsis (or nodding in purple-flowered *A. neomexicanus* of oak and pine woods in mountainous centr. New Mexico); *petals* ochroleucous only in some forms of *A. lentiginosus*, with papery, fully bilocular pods (36)
36. Pod unilocular ..... Sect. *Argophylli* (p. 622)
36. Pod bilocular (37)
37. Pod (inflated or not) terete or grooved along both sutures, often more deeply grooved ventrally than dorsally, never trigonous (38)
38. Valves of the pod fleshy, at least 1 mm. thick when first formed, becoming leathery or pithy when ripe ..... Sect. *Sarcocarpi* (p. 752)
38. Valves of the pod much thinner, becoming stiffly papery to papery-membranous ..... *A. lentiginosus* (p. 911)
37. Pod (not inflated) trigonous, keeled ventrally and flattened or grooved dorsally ..... Subsect. *Pseudargophylli* (p. 652)

Regional Key X. Pacific Coast (cismontane Washington, Oregon and California, and Baja California)

1. Annual plants with small flowers, the keel not over 8 mm. long; *racemes* capitate, subumbellate, or racemose, but if racemose not over 10-flowered, and the axis not over 3 cm. long in fruit (2)
2. Pod less than 5 mm. long, ovoid or subglabose, tranversely wrinkled, bilocular, 2-seeded ..... Sect. *Microlobium* (p. 1130)
2. Pod larger, either strongly turgid to inflated or narrow and elongate, several-seeded (3)
3. Pod bladdery-inflated, unilocular ..... Sect. *Inflati* (p. 825)
3. Pod not inflated, grooved dorsally, bilocular ..... Sect. *Leptocarpi* (p. 1008)
1. Perennial plants, but if short-lived, or flowering the first season, or monocarpic, then the flowers larger, the keel at least 9 mm. long, or the racemes loosely many-flowered (4)
4. Plants of the Olympic Mountains, Washington ..... *A. Cottoni* (p. 142)
4. Plants not of the Olympic Mountains (5)
5. Stipules, at least at the lowest nodes, connate (6)
6. Leaflets of well-developed leaves subtending the peduncles more than (21) 23; robust plants of low elevations along the coast of California and n. Baja California, the South Coast Ranges, the Great Valley s.-ward from San Francisco Bay region, and insular (7)
7. Stipules herbaceous, small, tomentose externally; *pod* sessile, bladdery-inflated; n. Baja California and insular off s. California ..... Sect. *Anemophili* (p. 794)
7. Stipules scarious or early becoming so, thinly pubescent or glabrate dorsally;

if of the Channel Islands or Baja California the pod either stipitate or borne on a stipelike gynophore (8)
8. Pod sessile or elevated on a stipelike gynophore ..... Sect. *Densifolii* (p. 799)
8. Pod truly stipitate, the stipe continuous with the body of the pod ..... Sect. *Trichopodi* (p. 815)
6. Leaflets not more than 21 (23) in any one leaf, or if occasionally so then the plants of montane elevations in the Sierra Nevada or North Coast Ranges (9)
9. Petals pubescent; n. Sierra Nevada ..... *A. Austinae* (p. 1118)
9. Petals glabrous (10)
10. Pod pendulous, stipitate, either elongate and laterally compressed, or bladdery and balloon-shaped, always unilocular, the valves papery ..... Sect. *Cusickiani* (p. 317)
10. Pod sessile, or if stipitate then either erect, inflated and bilocular, or humistrate (either stipitate or sessile) and fleshy becoming leathery or subligneous (11)
11. Dwarf, tufted plants of n. Baja California, the stems 1 dm. long or less; *pod* ± 1.2 cm. long; *keel-tip* narrowly triangular, beaklike ..... *A. circumdatus* (p. 975)
11. Taller, diffuse plants of California, with larger pods and obtuse keel-tip (12)
12. Root-crown superficial; *pod* erect (stipitate), the body inflated, papery, fully bilocular below the beak; Sierra Nevada ..... *A. Bolanderi* (p. 558)
12. Root-crown subterranean; *pod* humistrate (either sessile or stipitate), fleshy becoming subligneous, unilocular; local in n. Sierra Nevada and in the Transverse Ranges of s. California ..... Sect. *Bicristati* (p. 560)
5. Stipules all free (13)
13. Plants of the outer California islands (San Nicolas, Santa Barbara, and San Clemente) with softly tomentose foliage and pendulous, stipitate, dorsally grooved, bilocular pods ..... Sect. *Neviniani* (p. 461)
13. Plants of the mainland, or if insular on other islands and the pod bladdery, unilocular (14)
14. Low, tufted, or matted plants, softly tomentulose with extremely fine, entangled, cottony hairs (or if the hairs mostly straight the flower scarlet); *pod* sessile, tomentulose, or densely white-woolly or -hirsute ..... Sect. *Argophylli* (p. 622)
14. Taller, caulescent plants, not softly cottony-tomentose, or if somewhat so the pod either stipitate, or merely strigulose (15)
15. Flowers very small and numerous, 20–95 to the raceme, reflexed, the banner 5–6 mm. long; *racemes* elongate, very narrow, the axis 1–3 dm. long; local in the California Coast Ranges ..... *A. Clevelandi* (p. 1096)
15. Flowers fewer, or if nearly as many larger, the banner 9–12 mm. long; *raceme-axis* shorter (16)
16. Pod inflated, ± bladdery, the valves papery (sometimes stiffly so), either uni- or bilocular (17)
17. Pod sessile (18)
18. Pod unilocular ..... Sect. *Inflati* (p. 825)
18. Pod bilocular (below the beak) ..... Sect. *Diphysi* (p. 910)
17. Pod stipitate ..... Sect. *Trichopodi* (p. 815)
16. Pod not inflated, fully bilocular (19)
19. Pod very small, 6.5–9 mm. long, sessile, deciduous, little exserted beyond the ruptured calyx; *petals* marcescent; coarse, leafy, tomentulose plants of the chaparral belt in Los Angeles and Orange Counties, s. coastal California ..... *A. Brauntonii* (p. 1120)
19. Pod larger, at least 11 mm. long, stipitate (even though shortly so), persistent, long-exserted beyond the usually unruptured calyx; *petals* deciduous; range otherwise (20)
20. Body of the pod subterete becoming laterally compressed, bicarinate by prominent, cordlike sutures, the glabrous valves fleshy becoming stiffly leathery or subligneous (21)
21. Leaflets linear-oblong, often more densely pubescent above than beneath; *pods* arcuate-erect on stout, ascending pe-

duncles; South Coast Ranges and s. California ..... *A. pachypus* (p. 487)

21. Leaflets of a broader type, glabrous or more thinly pubescent above than beneath; *pods* essentially pendulous, if apparently ascending humistrate, the peduncle weak and decumbent; Sacramento Valley, California, n. into s.w. Oregon ..... *A. accidens* (p. 513)

20. Body of the pod trigonous or compressed-trigonous, ± grooved dorsally, keeled only ventrally, the strigulose valves little or not fleshy, becoming papery or thinly leathery (22)

22. Petals whitish or ochroleucous; *pod* pendulous; Sierra Nevada and North Coast Ranges, California, n. into Oregon ..... Sect. *Miselli* (p. 438)

22. Petals pink-purple; *pod* incurved-ascending; Baja California ..... *A. Orcuttianus* (p. 538)

Regional Key XI. Mexico and Central America (excluding Baja California)

1. Annual plants (of Sonora n.-ward) with tiny flowers and very small, subglobose, 2-seeded pots ..... *A. didymocarpus* (p. 1133)

1. Annual or perennial, but if annual the pod linear in profile, or peltiform, at least 4-, usually several-seeded (2)

2. Pubescence of the leaves (or of the whole plant) dolabriform (3)

3. Diffuse or prostrate, strongly caulescent plants with small flowers, the calyx-tube campanulate, the banner 6–12 mm. long (4)

4. Stipules all free. Pod ascending, narrowly oblong in profile, 1.5–3 cm. long, triquetrous, bilocular; Sonora and perhaps n.-w. Chihuahua ..... *A. arizonicus* (p. 1018)

4. Stipules all connate, scarious (5)

5. Root-crown ordinarily subterranean; *pod* deflexed, 7–12 mm. long, fully bilocular; Nuevo León and San Luis Potosí s.-ward ..... *A. hypoleucus* (p. 1100)

5. Root-crown superficial; *pod* ascending (10) 13–20 mm. long, unilocular; n. Sonora and n.-w. Chihuahua ..... *A. humistratus* (p. 383)

3. Tufted, shortly caulescent or subacaulescent plants, with large (purple) flowers, the calyx-tube 6–10.5 mm., the banner 16–24.5 mm. long. Pod ascending (humistrate), crescentic, mostly 2–4 cm. long, unilocular, laterally compressed at both ends, obcompressed at the middle ..... *A. amphioxys* (p. 703)

2. Pubescence of the whole plant basifixed (6)

6. Stem, leaf-rachis, and peduncle densely hispid-pilosulous with straight, horizontal or ± retrorse hairs; *pod* sessile, narrowly oblong in profile, compressed-triquetrous, fully bilocular, glabrous; Coahuila ..... *A. Greggii* (p. 1088)

6. Stem, leaf-rachis, and peduncle variably pubescent to nearly glabrous, but the hairs always either appressed or ascending; *pod* either of different form, or if of the same form then pubescent (7)

7. Stipules all, or at least those at base of the stem, connate (8)

8. Pod pendulous, stipitate (even though shortly and obscurely so) (9)

9. Body of the pod mostly obcompressed and excavated dorsally, subunito fully bilocular, but a septum always present even though very narrow; scentless plants, not of seleniferous soils, widespread nearly throughout temperate Mexico and s.-ward ..... Sect. *Strigulosi* (p. 146)

9. Body of the pod sharply triquetrous, unilocular; coarse, ill-scented (seleniferous) plants, known in Mexico only from San Luis Potosí ..... *A. racemosus* (p. 414)

8. Pod either deflexed or ascending, but sessile (10)

10. Body of the pod unilocular (if the flower very small, cf. *A. pueblae*, p. 178) ..... Sect. *Scytocarpi* (p. 199)

10. Body of the pod semi- or fully bilocular (11)

11. Pod didymous, inflated, retuse at both ends ..... *A. diphacus* (p. 1122)

11. Pod ovate or oblong in profile, triangular-beaked at apex, not inflated ..... Sect. *Strigulosi* (p. 146)

7. Stipules all free (12)

12. Flowers extremely large, the banner ± 3.5 cm. long, the petals whitish; Chihuahua ..... *A. Hartmanii* (p. 1157)

12. Flowers variable in size, but if over 3 cm. long the petals scarlet, if whitish then less than 2.5 cm. long (13)
13. Plants densely pilose and tomentulose with shorter, curly hairs and longer, spreading (exceptionally all appressed), spirally twisted ones up to 1–2 mm. long, the vesture turning rusty when dry (14)
14. Stems usually many, decumbent or prostrate, mostly shorter than the longest leaves and inflorescences, the herbage tufted (if strongly caulescent the flowers scarlet); *peduncles* mostly incurved-ascending at anthesis, decumbent and humistrate in fruit; *flowers* ascending; *pod* humistrate, readily deciduous when ripe ..... Sect. *Mollissimi* (p. 732)
14. Stems few, erect, strongly caulescent; *peduncles* erect; *flowers* ochroleucous, nodding at anthesis, but the pods erect on thickened pedicels, persistent and dehiscent on the raceme ..... *A. giganteus* (p. 750)
13. Plants variably pubescent, but the hairs shorter, none spirally twisted (15)
15. Pod subsymmetrically or obliquely ovoid or subglobose, bladdery-inflated, uni- or bilocular, the valves papery or papery-membranous (16)
16. Flowers very small, and on the principal racemes many and remotely racemose, over 15 and up to 50, the calyx-tube 1.6–2 mm., the banner ± 5.5–6.5 mm. long; *pod* small, 4–8 cm. long, moderately inflated, persistent, uni- or subunilocular; Sierra Madre in Chihuahua ..... *A. scalaris* (p. 194)
16. Flowers either fewer or larger, usually both; *pod* (mostly larger) deciduous from the receptacle or from a stipelike gynophore (17)
17. Pod unilocular ..... Sect. *Inflati* (p. 825)
17. Pod (at least below the beak) bilocular (18)
18. Flower small, the banner ± 7–9.5 mm. long; *pod* less than 1 cm. long, retuse at both ends, minutely apiculate-beaked, bilocular to apex ..... Sect. *Diphaci* (p. 1121)
18. Flower much larger, the banner well over 1 cm. long; *pod* much larger, acuminate distally into a triangular, unilocular beak ..... *A. lentiginosus* (p. 911)
15. Pod narrowly elliptic, linear-oblong, narrowly oblong-elliptic or obliquely obovate in profile, but not inflated, if of relatively broad outline the valves firm (19)
19. Flowers relatively large, the banner 12–23 mm. long; low, tufted plants entering n.-e. Mexico from New Mexico and Texas, with stems mostly shorter than the longest leaves and inflorescences, and humistrate, ascending, oblong-ovoid or -ellipsoid pods 1.3–3.8 cm. long, 5–10 mm. in diameter ..... Sect. *Argophylli* (p. 622)
19. Flowers mostly much smaller, but if of the same size-range the pod narrower, linear-oblong, compressed-triquetrous (and bilocular) (20)
20. Plants very slender (perennial but often flowering the first season), the leaves with 5–11 distant, linear-oblong leaflets; *peduncles* dimorphic, the early ones very short, 1–2-flowered, the later ones longer, up to 7-flowered; *flowers* minute, the banner 5–5.5 mm. long; *pod* pendulous, sessile, compressed-triquetrous, subunilocular, 6–10 mm. long ..... *A. quinqueflorus* (p. 480)
20. Plants variable in stature, but if the flowers as small and the leaflets as few then the root annual and pod larger; if the *pod* as small, the flowers much more numerous; *pod* fully bilocular (21)
21. Pod declined or deflexed, sessile or elevated on a stipelike gynophore, the body very strongly dorsiventrally compressed, peltiform or shield-shaped, ± as broad as long or not much longer ..... Sect. *Scutanei* (p. 1127)
21. Pod ascending, spreading, or deflexed, sessile or shortly stipitate, the body mostly lance- or linear-oblong in profile, rarely half-ovate, in any case triquetrous or compressed-triquetrous, rarely subterete, twice to many times longer than wide (22)
22. Pod triquetrous, triangular in section (23)

23. Plants annual ..... Sect. *Leptocarpi* (p. 1008)
23. Plants perennial (24)
24. Pod strictly sessile, usually deciduous, if persistent then ascending or incurved-ascending (25)
25. Pods deflexed; *flowers* very small, early deflexed, usually very numerous (15–65) ..... Sect. *Micranthi* (p. 1089)
25. Pods ascending or loosely spreading; *flowers* either fewer or larger, ascending or loosely spreading ..... Sect. *Leptocarpi* (p. 1008)
24. Pod stipitate, even though shortly so, persistent on the receptacle, pendulous ..... Sect. *Miselli* (p. 438)
22. Pod subterete, the cross-section nearly round; densely silvery-pubescent plants of extreme n.-w. Sonora ..... *A. lentiginosus* var. *borreganus* (p. 953)

PHALANX A

The PHACOID ASTRAGALI

I. Sectio PHACA

Ours caulescent perennials, with subterranean root-crown and stoloniform, creeping caudex-branches; *vesture* basifixed; *stipules* dimorphic, the lowest united on the side corresponding with the suppressed petiole into an entire, simple, loosely amplexicaul blade, the upper ones ample, semi- or fully-amplexicaul, but separate and free; *leaves* imparipinnate, with 7–13 (15) large, thin-textured, reticulate-veined leaflets, all petiolulate; *flowers* loosely but shortly, sometimes subumbellately racemose, nodding at full anthesis, of moderate size, the banner mostly 11–17.5 mm. long; *pedicels* persistent or very tardily disjointing with the fruit; *calyx-tube* campanulate or subcylindric, sometimes oblique but not truly gibbous at base; *petals* whitish or cream-colored, only very slightly graduated, the keel-tip obtuse; *pod* pendulous, stipitate, continuous with the receptacle, the body obliquely ellipsoid or lance-ellipsoid, ± inflated and commonly bladdery, variably compressed, the papery-membranous, unmottled valves not inflexed, but the dorsal suture sometimes a trifle elevated and prominent within the cavity; *dehiscence* ventral, from the base upward the length of the suture; *ovules* 6–10.—A largely Asiatic section of mesophytes, most highly diversified in the mountains of central Asia but extending westward into alpine and arctic Europe; Siberia, and Japan; 2 in North America, from Alaska to southern Quebec, south in the Rocky Mountains to Colorado.

ASTRAGALUS sect. PHACA (L.) Halaczy, Prod. Fl. Graec. 1: 429. 1901, based on *Phaca* L., Sp. Pl. 755. 1753 & Gen. Pl., Ed. 5, 335. 1754.—Generitypus (Bss., Voy. Esp. 2: 177. 1839, by implication): *P. alpina* L. = *Astragalus frigidus* (L.) Gray (non *A. alpinus* L.).—*Astragalus* subgen. *Phaca* (L.) Bge., Astrag. Geront. 1: 18. 1868. *Astragalus* ser. *Phaca* (L.) Sheld. in Minn. Bot. Stud. 1: 117. 1894. *Cystopora* Lunell in Amer. Midl. Nat. 4: 428. 1916, an illegitimate substitute for *Phaca* L. non Dioscorides. *Phaca* subgen. *Podocystis* Rydb. in N. Amer. Fl. 24: 329, in clave. 1929, the typical subgenus. *Phaca* subgen. *Podocystis* sect. *Frigidae* Rydb. in op. cit.: 334. 1929, the typical sectio.

Phaca sect. ("Rötte") *Cenantrum* C. Koch, Syn. Fl. Germ. Helv. 179. 1837, the name superfluous, because by definition the typical sect. of *Phaca*.—Sp. lectotypica: *P. frigida* L. = *Astragalus frigidus* (L.) Gray.—*Astragalus* subgen. *Phaca* sect. *Cenantrum* (C. Koch) Bge., Astrag. Geront. 1: 23. 1868, superfluous because the typical sect. of subgen. *Phaca*. *Astragalus* sect. *Cenantrum* subsect. *Elliptica* Gontsch. in Fl. U. R. S. S. 12: 30. 1946, the typical subsect.

Astragalus sect. *Alpini* Jones, Rev. Astrag. 131. 1923.—Sp. lectotypica: *A. alpinus* (L.) Sheld. (non *A. alpinus* L.), based on *Phaca alpina* L. = *A. frigidus* (L.) Gray.

The sect. *Phaca* is an extensive one, still in need of a comprehensive revision; it contains several species known to me only from the literature, and its circumscription in these pages is designed to accommodate only the American members and the sectional typus. In the New World sect. *Phaca* is taxonomically isolated and easily distinguished from all other groups. Its leading features are a stoloniferous habit (the subterranean parts are seldom seen in herbarium specimens), large foliaceous or papery stipules of which those at the lower (leafless) nodes are united into an entire blade, nodding flowers, and thin-textured, swollen pods pendulous on a slender stipe. The American species of sect. *Phaca* were included by Gray (1864, p. 219) in a loosely defined circumboreal *A. frigidus,* and this was appended to a heterogeneous sect. *Inflati* inexactly and artificially characterized by a papery, inflated, unilocular fruit. Jones (1923, p. 136) removed *A. frigidus* (with a variety equivalent to our *A. umbellatus*) and *A. americanus* to a sect. *Alpini,* where they were associated with members of our sects. *Hemiphragmium, Oroboidei,* and *Astragalus,* from all of which the combination of characters just mentioned quickly distinguish them. It should be noticed that sect. *Alpini* Jones embraced both *A. alpinus* L., under the name *A. andinus* Jones, and *A. frigidus* (L.) Gray, under the later homonym *A. alpinus* (L.) Sheld. Choice of the latter as typus of an ill-named and ill-defined group disposes of the name *Alpini* in the synonymy of sect. *Phaca.*

The American phacas are readily separated from one another, but each is closely related to *A. frigidus,* of which each was first described as a variety. The three species are almost identical in the form of the stipules, leaves, flowers, and fruits, and the differential characters are found chiefly in stature, number and size of the flowers, and amount and distribution of pubescence on calyx and pod. Rousseau (1933, p. 44, sequ.) has analyzed most of these features and illustrated (fig. 13) petals, calyces, and pods, but the drawings show little more than ideal mean measurements and ignore the overlapping extremes. In stature, in number and size of the flowers, and in vesture of calyx and pod, *A. frigidus* stands about midway between *A. umbellatus* and *A. americanus.* It may be distinguished from *A. umbellatus* by its ordinarily taller stems (mostly 1.5–6 dm. long), more numerous (up to 20), slightly smaller flowers, shorter and narrower, subglabrous calyx-tube, and, as a rule, less densely pubescent pod. It differs from *A. americanus* in its usually shorter stems, slightly larger flowers, and loosely strigulose rather than glabrous or minutely puberulent pod; but the long pedicels (4.5–9 rather than 3.5–5 mm.) of *A. americanus* are the best differential character. The status of these species is complicated by the existence in eastern Asia of such closely related forms as *A. frigidus* ssp. *parviflorus* (Turcz.) Hult. and *A. saralensis* Gontsch., and in arctic European Russia of the poorly characterized *A. Grigorjevii* B. Fedtsch. Until the whole complex can be studied as a unit, it seems best to accept the American entities, here easily defined, at the level of species.

The history of *Phaca* is long and rather complex. The word *phaca* was current in Greece of the classical era, where it meant lentil soup or pottage; its derivation is from the root *phakos,* the lentil itself. As a modern genus *Phaca* enters our scheme of nomenclature with the fifth edition of Linnaeus's Genera and the first of the *Species Plantarum* (1754, 1753), but its formulation goes back to the second edition of the Genera (1742). There are several interesting points about the original description of *Phaca* L. In the first place, the name bore the asterisk signifying that Linnaeus had drawn up the generic character with the help of a living plant. Secondly, the monotypic genus *Astragaloides* Tournef. (Inst. Rei Herb. 1: 399, Pl. 233. 1700) was given as a synonym. Thirdly, the pod was described as "oblongum inflatum, sutura depressa versus inferiorem, uniloculare." Linnaeus further mentioned that some *Phacae* had straight pods, others a pod so far recurved that the tip almost reached the base; and he remarked that since the septum within the pod of some *Astragali* was incomplete, a close affinity between bilocular *Astragalus* and unilocular *Phaca* was apparent.

With *Species Plantarum* (1753, p. 755) we have the first illustration of what Linnaeus had in mind in the early editions of the Genera. Three species were listed: *Phaca baetica* (= *Astragaloides* Tournef. = *Astragalus lusitanicus* Lamk.), *P. alpina* (= *A. frigidus* (L.) Gray), and *P. sibirica* (a species of *Oxytropis* DC.). None of these has a recurved pod, so we must assume that even though the entry for *Phaca* had been repeated verbatim from the second to the fifth (and actually on to the seventh, 1767) edition of the Genera, some modification must have taken place between 1742 and 1753 in Linnaeus's concept of the genus. It should also be noticed that in editions of the *Systema Naturae* (Ed. 7, p. 123. 1748; Ed. 9, p. 127. 1756) appearing contemporaneously with the Species and Genera, Linnaeus was characterizing the legume of *Phaca* as "semibilocular." Thus the stage was set very early for confused and contradictory interpretations of the genus.

In 1763 Adanson, a severe critic of the Linnaean system, revived *Astragaloides* Tournef. for *Phaca.* Jussieu (Gen. Pl. 359. 1789) accepted *Phaca,* but attributed to it a pod semibilocular by intrusion of the ventral suture, a character of *Oxytropis,* but not of Linnaeus's two principal *Phacae, P. frigida* and *P. baetica.* Pallas (1800) omitted *Phaca* from his monograph

of *Astragalus,* but he had already sensed the difficulties involved in such a course. In his Introduction Pallas pointed out the extreme variability of the *Astragalus* pod within what seemed to be a natural and essentially homogeneous genus; he treated as *Astragali* several species with unilocular but uninflated pod (some now referred to *Oxytropis*). He was aware that the genuine *Phacae,* with pods at once truly unilocular and bladdery, were closer to *Astragalus* than to *Colutea* (to which they had been referred by Lamarck), and he labeled as fictitious any astragaline genus characterized solely by a unilocular legume. Nevertheless Pallas followed the Linnaean disposition of *Phaca frigida.*

With the *Astragalogia* of DeCandolle (1802) *Phaca* took on a new vitality. But it was no longer exactly the *Phaca* of Linnaeus, and still less that of Jussieu, although the definition may have been colored by the latter's work. The *essential character* of the genus was altered in at least one important particular, and new species were introduced, some of them of an unforeseen character. DeCandolle's *Phaca* has an inflated, unilocular pod as required by Linnaeus, but the upper (seminiferous) suture is now said to be "tumid," and the whole fruit is thought to be resupinate by torsion of the pedicel (or perhaps the stipe). The genus still counted the old *Phaca baetica* and *P. alpina* among its numbers, but DeCandolle questioned the generic position of the first, and the bulk of his new *Phacae* are species now referred to *Astragalus* sect. *Hemiphragmium* because the fruit is in reality septiferous, even though narrowly and inconspicuously so. At the end of DeCandolle's genus we find very surprisingly introduced (as *Phaca astragalina*) the *Astragalus alpinus* of Linnaeus, which has a trigonous, definitely semibilocular pod. There are two things about *Phaca* sensu DC. which are extremely puzzling. The pod's ventral suture, which bears the seeds, is in all species admitted to the genus exactly filiform, not *tumid,* however we may interpret that term; moreover the pod is never resupinate, even though it may sometimes appear so if accidentally twisted in the press. It seems to me possible that the incipient septum in, for example, *A. alpinus,* was mistaken for the inwardly tumid ventral suture (i.e., the funicular flange, already noticed by Jussieu), for this error would automatically imply that the pod had been turned through 180° and at the same time explain how the septum of *Hemiphragmium* was overlooked.

Once endorsed by DeCandolle, *Phaca* became firmly established in the literature, even though the discrepancies between the generic character and the actual species did not go altogether unnoticed. In 1837 C. Koch proposed a *Phaca* sect. *Hemiphragmium* for two Candollean *Phacae* with semibilocular fruits, reserving for *P. frigida* (=*P. alpina*) a typical sect. *Cenantrum* (the name derived from Greek roots meaning empty and cave or chamber). Two years later Boissier took up the problem of *P. baetica,* a peculiar Mediterranean xerophyte already under suspicion as a *Phaca* and obviously not closely related to the mesophytic *P. frigida,* even though the pod (except for its thicker texture) is technically similar. Avoiding *Astragaloides* Tournef. ex Adans., probably because of its unattractive form, Boissier proposed for *P. baetica* a monotypic genus *Erophaca* (or spring phaca, for its precocious season of bloom). This was the first dismemberment of *Phaca* L. in its original sense. The exclusion of *P. baetica* left *P. alpina* and *P. sibirica* as a residue. As already noticed, the latter is an *Oxytropis,* and Boissier was no doubt aware of that fact. Whether intentionally or not, *Phaca* had been typified by *P. alpina.*

The majority of Old World *Astragali* have bilocular pods, and even though the troublesome *Hemiphacae* and *Oroboidei* (not to mention *A. alpinus*) remained a problem, it was the exploration of North America which produced the conclusive evidence against *Phaca* as a genus characterized by a unilocular pod. Hooker had followed DeCandolle loyally, describing all Douglas's and Drummond's peculiar unilocular *Astragali* as *Phacae.* But the difficulties mounted rapidly, and even by 1838 the *Phaca* of Torrey & Gray's Flora was unreasonably heterogeneous. When Gray came to review the North American species in 1863–4, he found that "the distinction between *Phaca* and *Astragalus* breaks down so completely and so variously, that the two genera are . . . no longer tenable." Gray arranged the North American species in two series, but *Phaca* appears in his Revision only as a synonym of an otherwise unnamed Series II.

Gray's verdict was by no means universally accepted in Europe—*Phaca* appears in floristic works well into the XX century—but his comprehensive view of *Astragalus* was adopted by Bunge (1868), who actually attributed the genus to Gray rather than Linnaeus. Bunge conceived of *Phaca* as a subgenus of *Astragalus* characterized by basifixed vesture, calyx unchanged after anthesis, and flowers either loosely racemose or subradical. The subgenus thus included all DeCandolle's *Phacae,* if we subtract *Erophaca* and the irrelevant *P. salsula* (=*Sphaerophysa salsula* (Pall.) DC.), and rather absurdly came to embrace not only the generitypus of *Phaca* L., i.e., *A. frigidus,* but also that of *Astragalus* itself, or *A. alpinus.* The Series *Phaca* of Sheldon's Preliminary List (1894, p. 117) is merely a substitution for Gray's unnamed Series II, and implied no advance in dealing with the *Phaca* problem. Lunell pro-

posed *Cystopora* as a direct substitute for *Phaca* L., not *Phaca* of Dioscorides, supposedly the equivalent of *Lens* L.

Although the concept of *Phaca* as a genus distinct from *Astragalus* should have died out with Gray and Bunge, it was merely dormant, awaiting the reaction in favor of small genera at all costs. In North America it reappeared with Britton & Brown's Flora (Ed. 1, 2: 304) in 1897, where it was again characterized by an inflated, unilocular pod. A great variety of *Astragali* of obviously diverse natures and origins within the genus are characterized by a legume of this type, although it is sometimes sessile and deciduous, at others sessile and persistent, and at yet others persistent but contracted into the stipe. As finally elaborated by Rydberg (1929, pp. 329–364), *Phaca* in North America embraced 3 subgenera, 22 sections, and no less than 99 species. In Rydberg's sense *Phaca* became a purely artificial category.

Two species have been designated generitypus of *Phaca*, namely *P. baetica* (=*Astragalus lusitanicus*) and *P. alpina* (=*A. frigidus* (L.) Gray). The first was the choice of Britton & Brown (Ill. Fl. Ed. 2, 2: 385. 1913), presumably based on the appearance of *Astragaloides* Tournef. in the original synonymy. The second and more acceptable candidate, *P. alpina*, was named by Hitchcock & Green (Prop. Brit. Bot., Internat. Bot. Congress, Cambridge, p. 176. 1929) and was confirmed by Rydberg (1929, p. 329). It is the only *Phaca* listed in *Species Plantarum* which Linnaeus could have seen in the living state, the only one represented in his herbarium by a specimen, and the only one therefore which could justify the asterisk in the protologue.

Key to the American Species of sect. Phaca

1. Stems 0.3–2 dm. long; *racemes* 5–11-flowered; *pedicels* densely villosulous, 3–5 mm. long in fruit; *calyx* 7.5–8.8 mm. long, the villosulous tube 6.3–7.5 mm. long, 3.7–5 mm. in diameter, the equally pubescent teeth 0.5–2 mm. long; *banner* 14.4–17.7 mm. long; *pod* densely black- or fuscous-pubescent; n.-w. Mackenzie, Yukon, Alaska ..... 1. *A. umbellatus*
1. Stems mostly 3–10 dm. long; *racemes* 10–25 (30)-flowered; *pedicels* sparsely villosulous, in fruit 4.5–9 mm. long; *calyx* 4.5–6.3 mm. long, the glabrous tube 4.3–5.8 mm. long, 3–3.8 mm. in diameter, the teeth 0.2–0.7 mm. long, ciliate; *banner* 10.6–14.2 mm. long; *pod* glabrous or minutely strigulose; Cordilleran, from Colorado to upper Yukon Valley, e. to Quebec ..... 2. *A. americanus*

1. Astragalus umbellatus

Low, sometimes diminutive but proportionately coarse and amply leafy, with a pluricipital root-crown giving rise to (seldom collected) obliquely ascending, subterranean, rhizome-like caudex-branches, the stems (distally), petioles, and lower leaf-surfaces thinly (or when young canescently) villosulous or villous with fine, loosely ascending and spreading, nearly straight (and sometimes a few shorter, curly) hairs up to 0.75–1.3 mm. long, the submembranous, reticulately veined leaflets bicolored, pallid beneath, green and glabrous above, the inflorescence fuscous- or black-hairy; *stems* erect or ascending, leafless at base, simple, (3) 5–15 (20) cm. long; *stipules* large, ovate, obovate, or broadly lanceolate, obtuse or subacute, several-nerved, 4–16 mm. long, the lowest united into an entire, loosely amplexicaul blade, the upper ones herbaceous (at least distally), fully amplexicaul but free, all glabrous or nearly so dorsally; *leaves* (2) 3–10 cm. long, the lower ones shortly petioled, the rest subsessile, with (5) 7–11 broadly ovate, rhombic-ovate, oblong-elliptic, or lance-oblong, obtuse or sometimes mucronulate and subacute, rarely subemarginate, flat leaflets (0.8) 1–3.5 cm. long, at base either rounded or broadly cuneate and often a trifle asymmetric; *peduncles* erect, 4–10 cm. long, nearly always longer than the leaf; *racemes* shortly but loosely, but seldom truly subumbellately 5–11-flowered, the flowers nodding at full anthesis, the axis a little elongating, (0.5) 1–3.5 (8) cm. long in fruit; *bracts* membranous, pallid, several-nerved, elliptic-oblanceolate or obovate, 5–10 mm. long; *pedicels* slender, densely fuscous-villous, at anthesis ascending, (1.5) 2.5–3.8 mm. long, in fruit arched outward, somewhat contorted, or deflexed, 3–5 mm. long; *bracteoles* 0; *calyx* 7.5–8.8 mm. long, villosulous (the teeth especially) with curly black, fuscous,

or rarely white hairs, the strongly oblique disc 0.8–1.1 mm. deep, the pallid, broadly campanulate tube 6.3–7.5 mm. long, 3.7–5 mm. in diameter, the broadly triangular teeth 0.5–2 mm. long, the whole becoming papery, marcescent unruptured; *petals* cream-colored; *banner* gently recurved through ± 45°, spatulate, 14.4–17.7 mm. long, the rather narrow claw abruptly expanded into a suborbicular or obscurely rhombic, shallowly notched blade 8.7–11 mm. wide; *wings* (0–1.5 mm. shorter) 13.2–16 mm. long, the claws 7.2–10.2 mm., the oblong-obovate or oblong, obtuse, often erose, nearly straight blades, 6.7–8.4 mm. long, 2.6–3.5 mm. wide; *keel* (nearly always a little shorter than the wings) 13.2–16 mm. long, the claws 7.2–9.7 mm., the lunately half-elliptic blades 5.2–7.4 mm. long, 2.9–3.8 mm. wide, incurved through 45–85° to the blunt apex; *anthers* 0.5–0.65 mm. long; *pod* pendulous, stipitate, the stipe 4–7 mm. long, the body obliquely lance-ellipsoid, tapering at both ends, decidedly inflated, 1.8–2.5 cm. long, 5.5–7.5 mm. in diameter, laterally compressed at base and the ventral suture there strongly convex-arcuate and salient, thereafter a little dorsiventrally compressed, with low-convex ventral and flattened dorsal faces, the thin, densely black- or brownish-villosulous valves becoming papery-membranous, not inflexed; *ovules* 7–10; *seeds* olivaceous, purple-speckled, smooth but scarcely lustrous, 2.4–3 mm. long.—Collections: 37 (o); representative: *Mexia 2080* (CAS, NY, WTU); *A. & R. Nelson 3954* (NY, SMU); *Galen Smith 2000* (NY); *Porsild & Breitung 10,304* (NY) *Frits Johansen 331a* (NY).

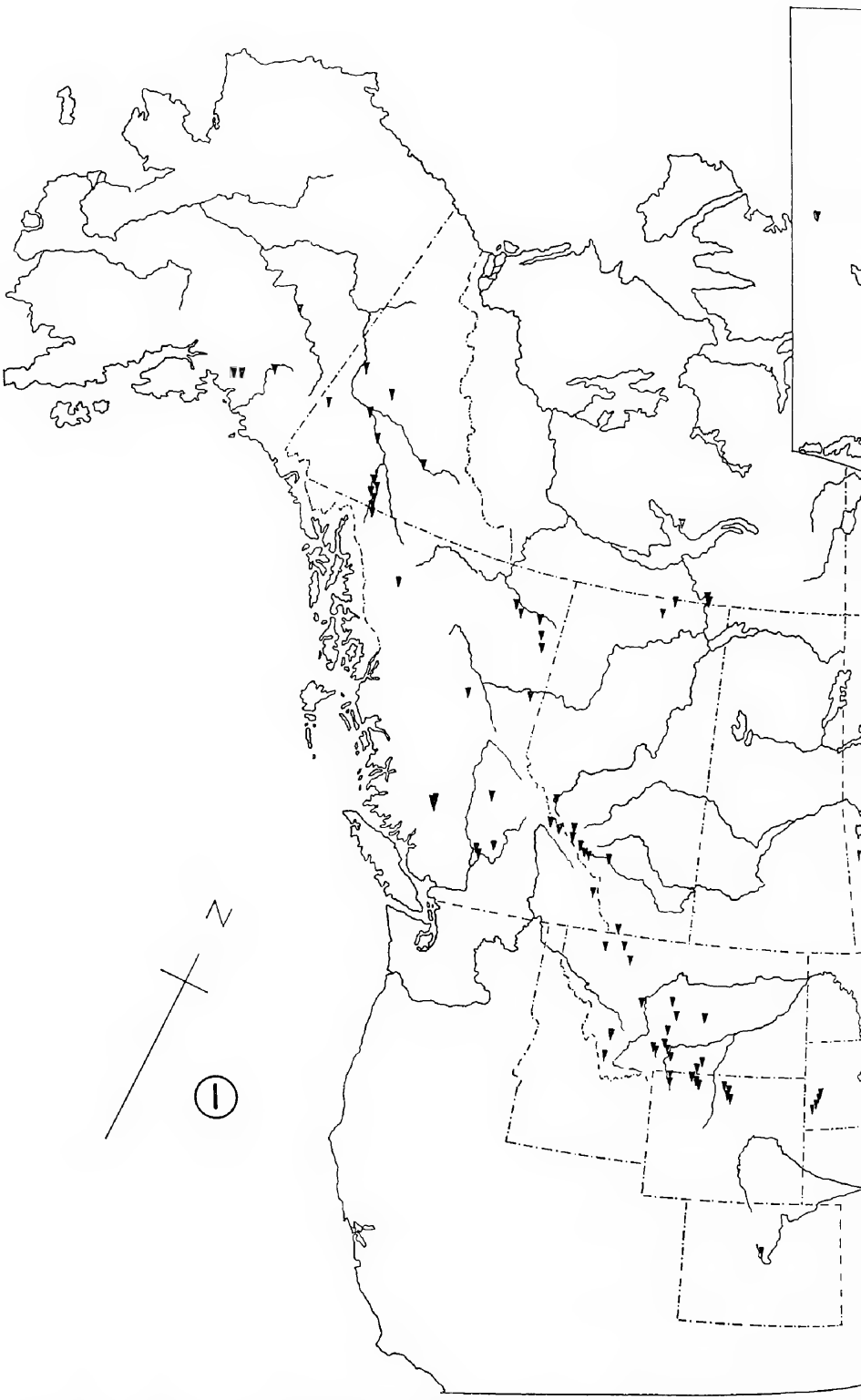
Arctic and subarctic shores, tundra, heathy hillsides, and openings in spruce forest, sometimes on silty gravel bars along streams, and ascending to open alpine ridges in the interior, 20–4500 feet, widespread and apparently common along the Arctic Coast west of the Mackenzie River Delta to Behring Strait, south to Alaska Peninsula (Shumagin Islands), and extending up the Kuskokwim and the south forks of the Yukon into interior Alaska and southwestern Yukon; also west around the coast of Siberia to Novaya Zemlya and Kolguev Island, south to the mountains of Kamtchatka.—Map No. 1.—June to August.

ASTRAGALUS UMBELLATUS (with flowers umbellately racemose) Bge., Astrag. Geront. 2: 29. 1869.—"Hab. in insula Nowaja-Semlia ad sinum Kostin-Schar (Al. Lehmann)."—No typus examined, but this the only Astragalus of its kind known from Novaya Zemlya and the interpretation traditional.

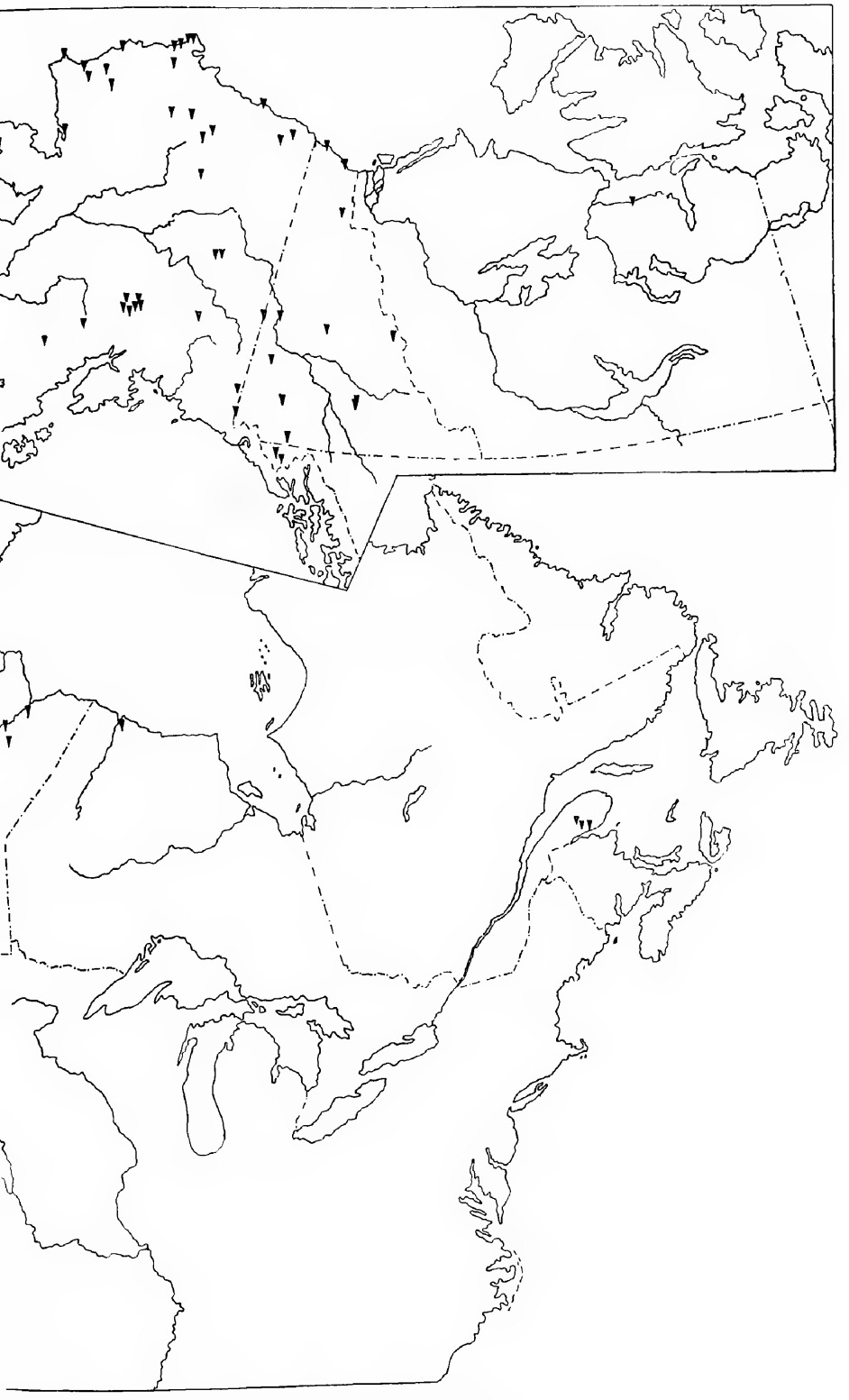
Phaca frigida γ *littoralis* (of the seashore) Hook., Fl. Bor.-Amer. 1: 140. 1831.—"Arctic shores, westward of the Mackenzie River, *Capt. Sir John Franklin and Capt. Back,* to Cape Lisburne, on Behring's Straits, *Messrs. Lay and Collie* in Capt. Beechey's Collection."—Lectotypus, labeled "Kotzebue's Sound, Capt. Beechey," K!—*Phaca frigida* α *demissa* (of low growth) Ledeb., Fl. Ross. 1: 576. 1842, a superfluous substitute. *Astragalus frigidus* var. *littoralis* (Hook.) Wats., Bibl. Ind. 192. 1878. *A. alpinus* var. *littoralis* (Hook.) Sheld. in Minn. Bot. Stud. 1: 133. 1894. *Phaca littoralis* (Hook.) Rydb. in Bull. N. Y. Bot. Gard. 2: 176. 1901. *Astragalus littoralis* (Hook.) Cov. & Standl. ex Mertie in U. S. Dept. Inter., Geol. Surv. Bull. 836 E. 365. 1932, nom. nud.

Astragalus frigidus var. *dawsonensis* (of Dawson, Yukon) Rouss. in Contrib. Lab. Bot. Univ. Montréal 24: 47, figs. 12–14. 1933.—"Yukon: Moosehide Creek, Dawson, June 16, 1914 (specimen en fleurs, No. 259, type) et July 16, 1914 (specimen en fruits, No. 477, cotype), *Alice Eastwood* (type et cotype dans l'herbier de l'Université de Montréal)."—Holotypi not examined; isotypi *(Nos. 259 & 477),* CAS, WS!—*A. americanus* × *umbellatus* Hult., Fl. Alaska & Yukon 1086. 1946.—"One specimen collected by EASTWOOD at Moosehide Creek (No. 477, US) seems to me to be the hybrid ... It was described by Rousseau ... as *Astragalus frigidus* var. *dawsonensis.*"—US!

The tundra milk-vetch, *A. umbellatus,* is easily recognized in America by the entire, unifoliolate, lower stipules characteristic of sect. *Phaca,* by its stature dwarf in proportion to the few large, veiny leaflets, and by the nodding, cream-colored flowers which give rise to stipitate, densely dark-hairy fruits in the form of a spindle somewhat laterally compressed at base and thereafter fore and aft. The plants vary in height, those from the coast above the Arctic Circle being generally dwarf or even diminutive, whereas those of the interior, especially when found on river banks and gravelly stream beds, tend toward a taller and ranker growth.



Map No. 1. Bottom, parts of United States and Canada. Range of *A. americanus*. Top, Al



n, and Mackenzie District. Range of *A. umbellatus*.

However, the variations in shape and size of the leaflets and in the length of the calyx-teeth and pods are poorly correlated with each other or with length of the stems. Thus the isotypi of var. *dawsonensis* that I have examined seem to represent no more than one of several minor variants of *A. umbellatus* which might equally well have been singled out for special mention. There is no evidence of real morphological intermediacy such as would be expected of a hybrid between *A. umbellatus* and *A. americanus,* although since the latter is common along the upper Yukon River opportunities for crossing must exist in that region.

2. Astragalus americanus

Robust, often coarse, amply leafy, the base of the stems and lower surface of the earliest (sometimes of all) leaves thinly villous with fine, spreading, and some retrorse, nearly straight or curly hairs up to 1–1.5 mm. long, the vesture commonly becoming shorter, sparser, and sometimes subappressed upward, the herbage green, but the leaflets conspicuously bicolored, pallid or subglaucescent beneath, green and glabrous above; *stems* erect and ascending, 3–7 (10, exceptionally only 1.5–2) dm. long, stout, striate, stramineous, usually hollow, leafless at base, simple or bearing slender spurs or branchlets at 1–4 nodes preceding the first peduncle; *stipules* very large and conspicuous, thinly herbaceous becoming papery-membranous in age, several-nerved, the lowest united behind the suppressed petiole into an entire, semiamplexicaul sheath, the rest broadly oblanceolate to elliptic-obovate, obtuse, embracing half or less than half the stem's circumference, early deflexed; *leaves* 6–16 cm. long, shortly petioled or the uppermost subsessile, with (7) 9–13 (15) broadly lance- or ovate-oblong, or elliptic, obtuse (sometimes minutely mucronulate) or shallowly emarginate, flat, thin-textured, reticulately veined leaflets (0.8) 1.5–6 cm. long; *peduncles* erect, rather slender, (3.5) 5–14 (19) cm. long, mostly equaling or shorter than (the lowest sometimes surpassing) the leaf, the racemes usually not projected beyond the uppermost leaves; *racemes* loosely but shortly 10–25 (30)-flowered, the flowers nodding, the axis not much elongating, (1) 2–5 cm. long in fruit; *bracts* thinly herbaceous, several-nerved, becoming deflexed and papery, oblanceolate, obtuse, 4.5–9 mm. long; *pedicels* subfiliform, thinly or minutely strigulose-villosulous with white or black hairs, ascending in bud, early arched outward or bent at base and horizontally spreading, or loosely refracted, at anthesis (3) 3.5–5 mm., in fruit 4.5–9 mm. long; *bracteoles* either 0, or when present attached to the pedicel at a point 2–3 mm. below the calyx; *calyx* (4.5) 5.3–6.3 mm. long, glabrous or nearly so below the white- or sometimes partly black-ciliate teeth, the oblique disc 1–1.4 mm. deep, the pallid, campanulate tube (4.3) 4.9–5.8 mm. long, 3–3.8 mm. in diameter, the broadly low-deltoid teeth 0.2–0.7 mm. long, often reduced to a shallow crenulation of the obliquely truncate orifice, the whole becoming papery, marcescent unruptured; *petals* white or pale cream-colored, little graduated; *banner* gently recurved through ± 35°, spatulate or broadly rhombic-oblanceolate, shallowly notched, (10.6) 11.6–14.2 mm. long, 6.3–8 mm. wide; *wings* (0.1–1.4 mm. shorter) 10.5–13.4 mm. long, the claws 5.6–7.4 mm., the narrowly oblong, obtuse or suberose blades (5.5) 6.2–7.4 mm. long, 1.6–2.3 mm. wide; *keel* 10.3–12.7 mm. long, the claws (5.5) 6–7.3 mm., the lunately half-elliptic blades (5) 5.3–6 mm. long, 2–2.5 mm. broad, gently incurved through 40–85° to the rounded apex; *anthers* (0.4) 0.45–0.6 (0.65) mm. long; *pod* loosely pendulous, stipitate, the stipe 4.5–7 mm. long, the obliquely ellipsoid body 2–2.8 mm. long, 6.5–9.5 mm. in diameter, tapering at both ends, bladdery-inflated, laterally compressed at base and the ventral suture there strongly convex-arcuate and prominent, thereafter somewhat dorsiventrally compressed, the ventral face low-convex, the dorsal face flattened, the thin, green, glabrous or minutely black-strigulose valves becoming papery and subdiaphanous, not inflexed; *ovules* 6–8 (9), commonly 7; *seeds* olive-brown, smooth but dull, 2.4–2.8 mm. long.—

Collections: 77 (o); representative: *Eastwood 421* (CAS, WS); *Porsild & Breitung 10,684* (NY); *Cody & McCanse 2718* (CAS); *J. W. & E. M. Thompson 338* (CAS, NY, RSA, WS, WTU); *W. A. Weber 2365* (NY, WS, WTU); *Hitchcock & Martin 7876* (WS, WTU,); *J. Macoun 65,087, 65,088* (NY); *C. L. Hitchcock 16,786* (NY, RSA, WS), *18,345* (ID, NY, RSA, WS); *Cronquist 8094* (NY, RSA, widely distributed); *Hall & Harbour 137* (CAS, NY); *Marie-Victorin & al. 33,844* (CAS, NY, OB, PH).

Meadows, brushy stream banks and lake shores, often about willow thickets and aspen groves, or at the edge of fir or spruce woods, sometimes on rock debris at the foot of cliffs or on shaded rock ledges, near sea level northward and up to 7200 feet in the Rocky Mountains, widespread and locally plentiful from upper Yukon Valley, eastern Alaska and Yukon, to Great Slave Lake, south to southern British Columbia and (east of the Continental Divide) along the main Cordillera to northwestern Wyoming; isolated in Colorado (± lat. 40° N., perhaps on the headwaters of the South Platte, not seen since Hall & Harbour), in the Black Hills, South Dakota, and in the Cypress Hills, southern Saskatchewan; east interruptedly through central Manitoba to the south shore of Hudson Bay, Ontario, and on Gaspé Peninsula, Quebec.—Map No. 1.—Late June to August.

ASTRAGALUS AMERICANUS (Hook.) Jones, Contrib. West. Bot. 8: 8. 1898 *("Americanus")*, based on *Phaca frigida* β *americana* (American) Hook., Fl. Bor.-Amer. 1: 140. 1831 *("Americana")*.—"Woody regions of the Rocky Mountains in lat. 52° to 56°, to Slave Lake in lat. 61°. *Dr. Richardson and Drummond.*"—Holotypus, *Richardson 276*, K! paratypus (*Drummond* from the Rocky Mountains), K!—*Astragalus frigidus* var. *americanus* (Hook.) Wats., Bibl. Ind. 193. 1878 *("Americanus")*. *A. alpinus* var. *americanus* (Hook.) Sheld. in Minn. Bot. Stud. 1: 133. 1894. *Phaca americana* (Hook.) Rydb. ap. Britt. & Br., Ill. Fl. 2: 304, fig. 2148. 1897.

Astragalus americanus fma. *glabrescens* (becoming hairless) Rouss. in Contrib. Lab. Bot. Univ. Montréal 24: 50. 1933.—"... Kicking Horse Lake, British Columbia, Aug. 11th, 1890, *Jas M. Macoun* ..."—Holotypus, US!

Astragalus americanus fma. *pallescens* (turning pale) Rouss. in op. cit.: 51. 1933.—"Dakota du Sud: Deerfield, July 11, 1930 *(A. C. McIntosh 1476)*..."—Holotypus, collected July 18, 1930, NY!

Astragalus americanus fma. *Williamsii* (Thomas Albert Williams, 1865–1900) Rouss. in op. cit.: 51. 1933.—"Wyoming: Welcome, July 26, 1897, *T. A. Williams*..."—Holotypus, NY!

Astragalus gaspensis (of Gaspé) Rouss. in op. cit.: 51, figs. 13, 15, 16. 1933.—"Province de Québec, péninsule de Gaspè... Little Cascapedia River, July 17, 1905 (Collins & Fernald, 107; specimen en fleurs. Cotype: Gray Herbarium...); rivière Petite Cascapédia, sur le talus rocheux à 5 milles de l'embouchure, 10 août, 1930 (Victorin, Rolland & E. Jacques, 33826; specimen en fruits. Type dans l'herbier de l'Université de Montréal)."—Holotypus, not examined; cotypus, GH!—*A. frigidus* var. *gaspensis* (Rouss.) Fern. in Rhodora 39: 312. 1937.

The American milk-vetch is easily distinguished from other tall, amply leafy *Astragali* of moist montane and forested regions of North America by its unifoliolate lower stipules and its pendulous, stipitate, swollen pod of subdiaphanously papery texture. It was subordinated by early writers to the Eurasiatic *A. frigidus*, from which it differs in its ordinarily greater stature, shorter, glabrous calyx-tube, long fruiting pedicels, and glabrous or minutely pubescent (not villosulous) pod. Despite its wide and interrupted range it is a comparatively uniform and stable species, the formae described by Rousseau being taxonomically insignificant variants of an extremely minor nature. The fma. *glabrescens* is the state characterized by a puberulent pod, sometimes found in the same population as the more ordinary glabrous one (e.g., *Hitchcock & Muhlick 13,486*, strigulose at NY, RSA, hairless at CAS; or *Tweedy 3174*, pubescent at WS, glabrous at NY). The fma. *pallescens*, described from fairly fresh material, supposedly had a whitish calyx and pure white rather than creamy petals, but the typus can no longer be distinguished from other specimens of the same age. The fma. *Williamsii* had wing-petals bearing a rudimentary auricle on the exterior margin, an approach to symmetry which occurs sporadically in perhaps half our species. The case of *A. gaspensis* is different chiefly on account of its great spatial isolation from the main Cordilleran range of *A. americanus*, although intermediate stations are now on record from Manitoba and Hudson Bay. Rousseau distinguished *A. gaspensis* on the basis of longer calyx-teeth separated by narrower sinuses and a

pod supposedly shorter and obtuse rather than attenuate at either end. The difference in shape of the fruit as illustrated by Rousseau (op. cit., fig. 13) is considerably exaggerated; the photograph (fig. 15) portrays a fruit which can be matched very precisely by some Rocky Mountain examples of *A. americanus*. The calyx-teeth of the Gaspesian plant are sometimes as little as 0.5 mm. long, when they lie well within the range of variation of the Cordilleran type. Calyx-teeth averaging a few tenths of a millimeter longer seem to be the only differential character of *A. gaspensis* and scarcely justify even the varietal rank to which it was reduced by Fernald.

II. Sectio ASTRAGALUS

Ours low, caulescent, perennial, with an initial taproot giving rise from the ± deeply buried root-crown to slender, widely creeping and branching, rhizomatous or stoloniform caudex-branches, these sometimes adventitiously rooting at the nodes and thereby vegetatively reproductive; *vesture* basifixed; *stipules* all, or at least the lowest, connate; *leaves* imparipinnate, with ± 15–25 petiolulate, thin-textured leaflets; *flowers* loosely and shortly racemose or subumbellate, early or at least ultimately nodding, small, the banner ± 7.5–13.5 mm. long; *pedicels* persistent, or tardily deciduous with the ripe fruit; *calyx-tube* campanulate; *petals* bluish- or lilac-purple, often pale, or whitish with maculate keel-tip, regularly or irregularly graduated, the keel-tip obtuse; *pod* pendulous, stipitate or subsessile, persistent on the receptacle, obliquely ovoid-ellipsoid, ellipsoid, or half-ellipsoid, straight or a little in- or decurved, bluntly trigonous or obcompressed-trigonous, flattened or sulcate dorsally, the papery-membranous valves not or narrowly inflexed; *dehiscence* apical, and sometimes downward through the ventral suture, often tardy; *ovules* (5) 6–10 (11).—Spp. ± 7, mesophytes, of circumboreal arctic, montane, and alpine dispersal, 1 widely diffused in northern and montane Eurasia and also in North America from Alaska to Baffin, south in the East to New England and Wisconsin and in the Cordillera to eastern Nevada, South Dakota, and northern New Mexico, several in the high mountains of central Asia, 1 local in the Rocky Mountains from Idaho to Colorado.

ASTRAGALUS sect. ASTRAGALUS, sens. emend. *Astragalus* L., Sp. Pl. 755. 1753, & Gen. Pl., Ed. 5, 335. 1754.—Sp. lectotypica: *A. alpinus* L.

Atelophragma sect. *Alpina* Rydb. in Bull. Torr. Club 55: 130. 1928.—Sp. typica: *A. alpinum* (L.) Rydb. = *A. alpinus* L.—Non *Astragalus* sect. *Alpini* Jones, Rev. Astrag. 131. 1923, based on *A. alpinus* (L.) Sheld., which = our sect. *Phaca* (L.) Halacs.

Astragalus sect. *Komaroviella* (for V. L. Komarov, editor of Fl. U. R. S. S., etc.) Gontsch. in Fl. U. R. S. S. 12: 876. 1946.—Sp. lectotypica: *A. alpinus* L.

Astragalus sect. *Komaroviella* subsect. *Dolichanthos* Gontsch. in op. cit.: 43. 1946.—Sp. lectotypica: *A. alpinus* L.

The limits of the present section were first established by Gontscharov, under the now superfluous epithet *Komaroviella*, to accommodate certain Old World species which had been disposed of in the classical texts as part of a heterogeneous sect. *Oroboidei* Gray or of the almost conterminous sect. *Hemiphragmium* Bge. The characters common to the Asiatic species, several of which are known to me only through descriptions or imperfect specimens, seem to be a diffusely branched subterranean caudex, connate stipules, and a pendulous, obtusely trigonous pod of submembranous texture ordinarily contracted at base into a stipe or stipelike neck, but either uni- or semibilocular. The Russian members of the section have been segregated into a subsect. *Macrotropis* distinguished by a strictly unilocular pod from the subsect. *Dolichanthos* composed of *A. alpinus* in the wide sense.

The section is adequately distinguished from sect. *Oroboidei* by its habit of growth and is adopted here without change except for the addition of the American *A. leptaleus*. This species agrees well with typical sect. *Komaroviella* except that the petals are more strongly graduated; because of the absence of a septum within the pod it would be referable technically to subsect. *Macrotropis*, but it does not closely resemble any particular member of that central Asiatic group.

The choice in these pages of a new standard species for *Astragalus* in no way modifies the concept of the genus as defined by Gray in 1864. Its effect will be felt only in the nomenclature

of categories intermediate between genus and species. However, it is quite possible that *Astragalus* may once again be broken up into component genera, and in this event the generitypus will determine the name and the nucleus of whatever is left as a residue after removal of the segregates. Because of this potential importance for the future, the selection of a new generic typus and the rejection of two species which have been elected as such in the past deserve explanation and critical comment.

In nominating *A. alpinus* to replace *A. christianus* or *A. Onobrychis* as generitypus of *Astragalus,* I have been guided by three principles. The chosen species must agree closely with the original description of the genus; it must be listed in the first edition of *Species Plantarum;* and since *Astragalus* is marked in *Genera Plantarum* with an asterisk, it must be a species known to Linnaeus in the living state at the time the original description was drawn up. Linnaeus first described *Astragalus* in the first edition of the Genera (1737, p. 215), and the entry for the genus was repeated verbatim up through the fourth edition. The only modification of the protologue in the fifth edition, the place of effective publication, was the inclusion of *Tragacantha,* hitherto kept distinct, but this has no bearing on the question at issue here, and it is fair to presume that the Linnaean concept of *Astragalus,* even though slighly widened by 1754, had been formed by 1737. The description of *Astragalus* is a rather generalized one which would apply to a variety of individual species; this indeed is the purpose of a generic description. One floral character mentioned by Linnaeus does, however, deserve special emphasis: the wing-petals were said to be shorter than the banner but of the same length as the keel. The generitypus ought therefore to be a species with a flower of this sort and one known to Linnaeus in the living state by the year 1737. The number of *Astragali* listed in *Species Plantarum* of 1753 which satisfy these two conditions is quite limited; but before we consider them in any detail, it will be well to dispose of the rival candidates for lecto-generitypus, *A. christianus* and *A. Onobrychis.*

The need for a standard species arose first in America when Rydberg, working on the genus in Colorado, began to follow up the generic dismemberment of *Astragalus* initiated by Steven in the Old World. Rydberg (1905, p. 658) wrote: "As the type I regard *A. christianus* L., which was an article of food in the desert regions of Syria and the Holy Land." This choice was accepted without question by Hitchcock & Green (Prop. Brit. Bot., Internat. Bot. Cong., Cambridge, 1929, p. 176), and as a consequence it was adopted in the official list of generitypes in Brittonia 6: 114. 1947. It was a choice based on misconceptions, however, as becomes apparent when we look back into the literature. The Linnaean *A. christianus* was a mixture of two discordant references, in the first place an *Astragalus orientalis maximus* etc., described by Tournefort in his Corollarium and Voyages, in the second an *A. Dioscoridis vulgo Christiana radix* of Dalechamp. We are exceptionally well informed as to Tournefort's plant through the description and figure in the Voyages and through the specimen in Tournefort's herbarium at Paris (P!). It was collected by Tournefort and his friends Aubriet and Gundelsheim on the moonlit night of June 13–14, 1701, between the villages of Conac and Iekmansour on the road from Trebizond (Trabzon) to Erzerum in Turkish Armenia; and was later cultivated at the Royal Garden in Paris. It is a tall, leafy plant with very numerous axillary flower-clusters arranged along the length of the stems, and is the typus of a sect. *Christiana* Bge. There is no specimen in the Linnaean herbarium representing Tournefort's species, and Linnaeus made no mention of an *A. christianus* either in *Hortus Cliffortianus* (1738) or in *Hortus Upsaliensis* (1748); it seems pretty certain that Linnaeus knew it only from the original description and illustration. The name *A. christianus* has been associated universally (by Lamarck, Willdenow, Boissier, Bunge, finally by Eig, 1955, pp. 45–47) with Tournefort's *A. orientalis maximus* etc., a species which has no reputation as a source of food and which is now thought to be endemic to Turkey, not Syria or Palestine. Rydberg's idea of a Syrian *A. christianus* with an edible root goes back to the Linnaean reference to Dalechamp, *Historia Generalis Plantarum,* App. 26. 1586. The *Astragalus Dioscoridis* etc., of Dalechamp is a mythical species, described and illustrated as a low, subacaulescent plant with subradical peduncles, a thick radish-like root, and fusiform fruits at once fleshy and inflated. The interpreters of Dioscorides in the XVI century, such as Marcellus Virgilius (1529), Matthioli (1550), and Ruellius (1552), all treat the same plant, said to inhabit the snowclad heights of Mt. Phaeneus in Arcadia; however, it is obvious that none of them knew it at first hand and the various crude portraits that they present of it are copies of copies of a lost original. I have been unable to discover anything exact about the so-called *radix christiana,* or its uses, or its source. The figures in the herbals suggest an *Astragalus* of sect. *Proselius* or sect. *Myobroma,* but the species could never be determined. The idea that *A. christianus,* or at least the root, was of Syrian origin derives from Rauwolf, a perspicacious Dutchman who visited the Orient in 1753–6 and published a book of his experiences. In Ray's translation of Rauwolf (*A Collection of Curious Travels,* p. 105. 1693) there is a good description of a leguminous plant found in the mountains near Aleppo, "very like unto *Astragalus* of Dioscorides, so that I really believe them to be the same." Subsequently

a specimen in Rauwolf's herbarium at Leyden was described by Gronovius (Fl. Or. 90. 1755), under the phrase-name *Astragalus species germ. Christiana radix, gallis Cices de montaigne.* It ought to be easy to identify a plant from Aleppo with brownish-purple flowers and pods described by the collector as resembling "long and thick and full Bladders, whereof some are as big as those of the Colutea"; but I cannot place it. It was perhaps not an *Astragalus* in our sense. The tradition that *A. christianus* was discovered in Syria by Rauwolf (cf. Sprengel, Hist. Rei Herb. 1: 379. 1808) was due partly to confusion of the two elements in the original Linnaean species and partly to the assumption, of a sort to which the herbalists were prone, that the Syrian plant was identical with something in Dioscorides. Linnaeus visited Gronovius in 1735 and thus may have seen Rauwolf's plant; but it remains inexplicable how with Tournefort's Voyages and Dalechamp's Historia before him he could have confused the tall Armenian species (to which the comment "Flores fere totum caulem cooperiunt" in *Species Plantarum* so obviously applies) with the acaulescent *Christiana radix* of the herbals. At first thought it must appear that the epithet *christianus* was derived from Dalechamp and adapted by Linnaeus to Tournefort's species; but there is an alternative explanation. Tournefort tells in the Voyages of the derision that he and his Christian friends aroused among the Moslem retinue of the Pasha of Erzerum as they botanized along the way on that moonlit night so long ago. And Linnaeus must have appreciated and approved of Tournefort's delight in "le bel Astragalus" revealed at sunrise in the nocturnal harvest. It is clear that Rydberg selected *A. christianus* as generitypus of *Astragalus* in the mistaken belief that it was the *Astragalus* of the ancients, that it was native to Syria and the Holy Land, and that it provided an article of food. As early as 1913 (in Britt. & Br., Ill. Fl.) he abandoned *A. christianus* as standard species and designated *A. Onobrychis* in its place.

In his "Genera of North American Fabaceae VI" (in Amer. Jour. Bot. 16: 206. 1929) Rydberg stated that the historical type of *Astragalus* was probably *A. christianus,* but "*A. Onobrychis* L. should be regarded as the nomenclatorial type according to the American Code." The reasons for this choice remain obscure to me, nevertheless. Linnaeus must have known of *A. Onobrychis* from the pages of Bauhin's Pinax and from Clusius; he may even have seen a specimen in the herbarium of Burser or elsewhere, but he mentioned the species for the first time only in *Species Plantarum* (1753), long after the *character essentialis* of *Astragalus* had taken form. There is no reason to suppose that he had seen *A. Onobrychis* in a garden, and the species is a Mediterranean one which he could not have encountered in his travels through Germany, England, or Scandinavia. Furthermore, the flower of *A. Onobrychis* has strongly graduated petals, with wings conspicuously surpassing the relatively short keel, and the species contradicts the original generic character of *Astragalus* in this respect. There can be no justification for adopting *A. Onobrychis* as generic typus.

In 1753 Linnaeus listed thirty-three species of *Astragalus* arranged by means of italicized phrases into four groups characterized by growth-habit: a) caulescent and erect; b) caulescent and diffuse; c) acaulescent; and d) suffruticose. The last group can be disregarded for our purposes, as it is more or less equivalent to *Tragacantha* Tournef., a genus recognized by Linnaeus concurrently with *Astragalus* in the early editions of *Genera Plantarum.* Of the remaining thirty-one species it seems proper to reject all which are mentioned for the first time by Linnaeus subsequent to 1738, the date of *Hortus Cliffortianus* which was in preparation at the time the first edition of the Genera appeared. The field is thereby narrowed to eight species: *A. alopecuroides, A. capitatus, A. galegiformis, A. Cicer, A. glycyphyllos, A. alpinus, A. sesameus,* and *A. Epiglottis.* The two last are Mediterranean annuals with wing-petals surpassing the keel, and there is no reason to suppose that either was in cultivation at Hartekamp or other botanical garden in northwestern Europe in Linnaeus's day. Linnaeus seems to have known *A. capitatus* only through Royen; according to Bunge (1869, p. 78) it is the same as *A. emarginatus* Lab. of Lebanon. The Caucasian *A. galegiformis* reached European gardens very early and may have been cultivated by Clifford, but its petals are conspicuously graduated and it can be eliminated on this score. The range of *A. Cicer* extends northward into Germany, but the species is cited by Linnaeus in *Hortus Cliffortianus* only from near Geneva in Switzerland, and it also disagrees with the character of *Astragalus* in the proportions of the petals. It is reasonable to choose the generitypus from among the remaining trio, *A. alopecuroides, A. glycyphyllos,* and *A. alpinus.*

The qualifications of *A. alopecuroides* are threefold. It is the species listed first in *Species Plantarum;* the rather prominent porrect keel-tip almost equals the wings in length; and it furnished the flower used by Tournefort (Inst. Rei Herb. Tab. 233) to illustrate the genus from which Linnaeus afterward borrowed the circumscription and name. But this last argument could be employed with equal force in favor of any of the several species (including one *Oxytropis*) that illustrate the *Astragalus* fruit in the same plate. Linnaeus cited *A. alopecuroides* as native to Spain (an error) and Siberia, and there is a possibility that it had been introduced to gardens by Gmelin prior to 1738. Nevertheless, I think the species should yield to one of the

two that were definitely known to Linnaeus as wild plants by that year, that is either *A. glycyphyllos* or *A. alpinus*.

Linnaeus says in *Hortus Cliffortianus* that he had seen and collected *A. glycyphyllos* in "Dalekarlia Sueciae" where he herborized in the summer of 1734. However, the old objection that the petals are evidently and regularly graduated disqualifies it as generitypus.

The successful candidate reached by elimination of its rivals is therefore *A. alpinus*, which Linnaeus encountered on his tour of Lapland in June and July, 1732. The description and illustration of *Astragalus alpinus minimus* in *Florula Lapponica* (218, tab. IX, fig. 1. 1737) constitute the first reference to an *Astragalus* in the Linnaean canon. In this work Linnaeus identified his Lapland plant with synonyms from J. Bauhin & Cherler's Historia, Tournefort's Institutiones, C. Bauhin's Pinax, as well as with species listed by Clusius and Scheuchzer, thereby establishing the species' arctomontane dispersal in Europe. The Lapland Flora was composed in 1732 and published in 1737, the same year as the first edition of *Genera Plantarum*. In *Hortus Cliffortianus*, which was written during 1737 and published the year following, Linnaeus gave an unusually detailed description of *A. alpinus* and modified the synonymy somewhat in order to exclude old references to *Oxytropis montana* DC., restricting the habitat to "*in alpibus* Lapponicis *vulgatissima*." So far as I can tell *A. alpinus* is the only member of the genus Linnaeus had studied in live detail up to the date of publication of *Hortus Cliffortianus*. The record shows that he recognized it as an *Astragalus* during the critical years when he was preparing the first edition of *Genera Plantarum*. The flower of *A. alpinus* is rather variable in the relative proportions of the petals. In the European alps and in North America the wings are commonly much narrower and a little shorter than the keel. However at high latitudes in Scandinavia (and thence eastward into Alaska) the wings are more strongly developed, and the common form of the flower in Lapland has wings and keel of about equal length. I cannot escape the conclusion that *A. alpinus* was uppermost in Linnaeus's mind when he was writing the description of *Astragalus* for the Genera.

In preparation of the notes on typification of *Astragalus* and *Phaca*, I have drawn heavily on Stearn's erudite introduction to the Ray Society's facsimile edition of *Species Plantarum* (1957).

Key to the American Species of sect. Astragalus

1. Stipe of the pod 1.4–3.5 mm. long, the valves inflexed as a narrow but evident septum 0.2–0.7 mm. wide; *racemes* (5) 7–23-flowered; circumboreal, s. in the w. mountains to n. New Mexico, the *petals* in the Rocky Mountains irregularly graduated, the broad keel surpassing (even though only slightly) the narrow wings and almost equaling the banner ..... 3. *A. alpinus*
1. Stipe of the pod not over 1.5 mm. long, often obscure and reduced to a narrow stipe-like neck, the valves not inflexed; *racemes* mostly 2–3, rarely 5-flowered; *petals* regularly graduated, the keel much shorter than the wings; Rocky Mountains from Montana and Idaho to Colorado ..... 4. *A. leptaleus*

3. Astragalus alpinus

Low, weak-stemmed, caulescent or apparently acaulescent, with a slender, oblique or vertical (seldom collected) initial taproot giving rise to horizontally creeping or obliquely ascending, at length repeatedly forking and adventitiously rooting, subterranean caudex-branches, the stems of the year aerial for a space of (0) 1–30 cm., commonly branched at the early emersed nodes, decumbent or incurved-ascending, each forming a small individual leafy tuft but these often running together into extensive patches or loosely woven carpets, the herbage ± strigulose, pilosulous, or villosulous with straight and appressed, straight and ascending, or more rarely ascending and curly or sinuous hairs up to (0.45) 0.5–0.9 mm. long, the leaflets sometimes equally pubescent on both sides but more often less densely so, or medially glabrescent, or quite glabrous above, the inflorescence nearly always black-hairy; *stipules* herbaceous becoming papery and brownish, or in age pallid and scarious, ovate, obovate, or broadly lanceolate, obtuse or subacute, 1.5–8 mm. long, mostly broader than the stem, the lowest ones shortest, connate at least at base and often through half their length into a loosely amplexicaul sheath; *leaves* (2) 3–11 (14) cm. long, with slender petiole and (11) 15–25 (27) mostly oval-ovate or -obovate, or suborbicular, obtuse or

retuse, sometimes lance-elliptic and then either obtuse or subacute, flat, thin-textured leaflets 2–20 (24) mm. long; *peduncles* erect or incurved-ascending, (2) 3–13 (17) cm. long, either longer or shorter than the leaf; *racemes* shortly and at early anthesis rather densely (5) 7–17 (23)-flowered, the flowers ascending in bud, early spreading and at full anthesis nodding (therefore ± retrorsely imbricated), the axis little elongating, 0.5–4 (7) cm. long in fruit; *bracts* submembranous, pallid or green-tipped, ovate-triangular, lanceolate, or linear-lanceolate, 1–2.5 mm. long; *pedicels* slender, very early arched out- and downward, at anthesis 0.5–1.6 mm., in fruit 0.7–2.3 mm. long, not or scarcely thickened; *bracteoles* O; *calyx* 3.2–6.3 mm. long, densely (sparsely) strigulose-villosulous with black and often some (as long or longer) white, exceptionally all white hairs, the slightly oblique disc 0.5–1 mm. deep, the membranous tube 2–4.1 mm. long, 1.3–3.6 mm. in diameter, the subulate or triangular-subulate teeth 0.9–2.8 mm. long, the ventral pair nearly always broadest and shortest, the orifice ± oblique, the whole becoming papery, marcescent unruptured; *petals* commonly bicolored, whitish proximally, the banner-blade broadly margined and veined or striped, the keel-tip maculate with pale or dark bluish-lavender, the wings pallid or white, rarely all purple (drying bluish-purple); *banner* moderately to quite strongly recurved, ovate-cuneate or somewhat rhombic-ovate, deeply or shallowly notched, (6.2) 7.4–13.6 (14.8) mm. long, (3.8) 4.6–8 (8.8) mm. wide; *wings* a little shorter, (6) 7–11.6 (13.1) mm. long, the claws gently incurved, the blades linear-oblong, narrowly elliptic-oblanceolate, rarely lanceolate, obtuse, or more rarely obovate and obtuse to erose-emarginate, straight or nearly so; *keel* varying from 0.5 mm. longer to 2.2 mm. shorter than the banner and from 1.8 mm. longer to 1.6 mm. shorter than the wings, the claws relatively short, the blades large, prominent, obliquely triangular or triangular-obovate, abruptly incurved through 75–90° to the broad, blunt apex; *anthers* 0.4–0.65 (0.7) mm. long; *pod* pendulous, stipitate, the slender stipe 1.4–3.5 mm. long, the body ellipsoid or half-ellipsoid, (6) 7–15 mm. long, 2.5–4.2 mm. in diameter, straight or gently lunate-incurved, abruptly cuneate or cuneately tapering at base, contracted distally into a short, subulate, cusplike beak, triquetrously compressed, carinate ventrally by the slender, straight or gently concave suture, the lateral angles obtuse, the lateral faces almost flat, the dorsal face widely and shallowly sulcate, the thin, green, finally papery-membranous and greenish-stramineous valves either villosulous or strigulose with black, mixed black and white, rarely all white hairs up to 0.2–0.8 mm. long (exceptionally glabrous), inflexed as a hyaline partial septum 0.2–0.7 mm. wide; *ovules* (5) 6–9 (11); *seeds* brown, reddish-brown, ochraceous, or pale yellowish, smooth or nearly so, dull, 1.8–3 (3.2) mm. long.

The alpine milk-vetch is the most widely dispersed of all astragali, yet when due allowance has been made for the diversity of soils, climates, and environments to which it has become adapted, it is a comparatively little variable species. Throughout a vast spatial and altitudinal range of dispersal the pod remains essentially uniform within a comprehensible (and in the context of the genus expectable) span of variation in length, width, and curvature. The principal segregates from *A. alpinus* distinguished in the past have been characterized by slight differences in size, coloring, and relative lengths of the petals, the taxonomic value of which is discussed below under the heading of the typical variety. An informed opinion on the whole racial situation in the species must be based on representative material from its whole range. Ample material of *A. alpinus* from Scandinavia and the European Alps has been available for comparison with the American plant, but a disproportionately small sample of central, eastern, and arctic Asian populations has prevented a thorough review of the whole problem. The following key is designed primarily for use in America.

Key to the American Varieties of A. alpinus

1. Hairs of the pod loosely ascending, up to 0.4–0.8 mm. long; widespread, but not of of low elevations in New England, Newfoundland, and s.-e. Quebec ..... a. var. *alpinus*

1. Hairs of the pod usually appressed, rarely ascending, but in any case shorter, up to 0.2–0.4 mm. long; river and lake shores in New England, Newfoundland, and s.-e. Quebec ..... b. var. *Brunetianus*

3a. ASTRAGALUS ALPINUS var. ALPINUS

Habit of the species, usually low, the stem mostly 1–15 (25) cm. long above ground; *racemes* usually compact, sometimes loose in age, the axis 0.5–4 (7) cm. long in fruit; *calyx* 3.2–6.6 mm. long, the tube 2.2–4 mm. long, (1.3) 2–3.7 mm. is diameter, the teeth 0.9–2.8 (3) mm. long; *banner* (6.2) 7.4–13.6 (14.8) mm. long, (3.8) 4.6–8 (8.8) mm. wide; *wings* 7.1–11.6 (13.1) mm. long, 1.6 mm. shorter to 1.6 mm. longer than the keel, the claws 2.2–4.7 mm., the blades 5–10.5 mm. long, 1.2–3.4 (3.7) mm. wide; *keel* 0.5 mm. longer to 2.4 mm. shorter than the banner, (7) 7.6–12.2 (12.7) mm. long, the claws (2.6) 2.8–5 (5.3) mm., the blades 5.1–8.7 (9) mm. long, (2.1) 2.5–4 mm. wide; *stipe* of the pod 1.4–3 mm. long, the *body* (6) 7–14 mm. long, 2.5–4.2 mm. in diameter, straight or gently incurved, villosulous with black or fuscous, often mixed with some (or many, exceptionally all) white hairs up to (0.4) 0.45–0.8 mm. long (very exceptionally calyx and pod glabrous).—Collections: 326 (xi) American + 66 (ii) Eurasian.

Arctic and subarctic shores, lake and river banks, moist (but often summer-dry) meadows, turfy hillsides, and talus, in mountain pine forests, aspen groves, and about willow or alder thickets along streams, from near sea level northward up to 11,500 feet in the Colorado Rocky Mountains, without apparent rock preference but perhaps most abundant on limestone, widely dispersed from Alaska to Baffin Island, south to Labrador and extreme northern Newfoundland, James Bay in Ontario, northern Wisconsin, southern Manitoba, and along the Rocky Mountains and their piedmont hills to the Black Hills of South Dakota, northern New Mexico, western Wyoming, northeastern Nevada, the Wallowa Mountains in northeastern Oregon and the Okanogan Highland in northeastern Washington; in the Old World circumpolar (excepting Greenland, where reportedly introduced sparingly) from Scotland and Scandinavia to Kamtchatka, south to the Pyrenees, Alps, Carpathians, Altai, Tian Shan, and northern Kurile Islands.—Map (in America) No. 2—Mid-April to August (September), flowering soon after the spring thaw.

ASTRAGALUS ALPINUS (alpine) L., Sp. Pl. 760. 1753.—"*Habitat in Alpibus* Lapponicis, Helveticis."—Holotypus labeled "*Astragalus alpinus.* Lapp.," LINN!—*Phaca minima* (smallest) All., Fl. Pedem. 1: 338. 1785, a legitimate substitute (non *P. alpina* L., 1753). *Phaca astragalina* (resembling *Astragalus*) DC., Astrag. 64. 1802, a superfluous substitute. *Colutea astragalina* (DC.) Poir. in Lamk., Encycl. Suppl. 1: 561. 1810. *Tragacantha alpina* (L.) O. Kze., Rev. Gen. 942. 1891. *Astragalus astragalinus* (DC.) Sheld. in Minn. Bot. Stud. 1: 65. 1891. *Astragalus phacinus* (resembling *Phaca*) Krause in Sturm, Fl. Deutschl., Ed. 2, 9: 66, 1901, a superfluous substitute. *Tium alpinum* (L.) Rydb. in Bull. Torr. Club 32: 659. 1905. *Phaca alpina* (L.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 371. 1906 (non L., 1753). *Atelophragma alpinum* (L.) Rydb. in Bull. Torr. Club 55: 130. 1928.

Phaca lapponica (of Lapland) DC., Prod. 2: 274. 1825.—". . . in Alpibus Lapponicis et Norvegicis et in Dahuria prope Ochotsk."—Lectotypus, one of 4 spms. most nearly agreeing with the description in leaflet-number, etc., labeled "*Astragalus alpinus* e Lapponia . . . 1821 . . . L. L. Lastavius," G-DC!—*Astragalus arcticus* (of Arctic provenance) Bge., Astrag. Geront. 2: 27. 1869, an illegitimate change of epithet and later homonym (non *A. arcticus* Willd., 1813). *Phaca arctica* (Bge.) Gand., Nov. Consp. Fl. Eur. 125. 1910, nomen. *Astragalus lapponicus* (DC.) B. Schischk. ap. Kryl., Fl. Sibir. Occ. 7: 1654. 1933, a later homonym (non *A. lapponicus* (Wahlenb.) Burnat, 1896 = *Oxytropis lapponica* (Wahlenb.) Gay). *A. alpinus* ssp. *arcticus* (Bge.) Hult., Fl. Alaska & Yukon 1083. 1944. *A. subpolaris* (of near polar dispersal) Boriss. & B. Schischk. in Fl. U. R. S. S. 12: 44. 1946, a legitimate substitute.

Astragalus alpinus var. ("varians") *dilutus* (washed out) J. M. Norm. in K. Nordsk. Vidensk. Skr. 5: 17. 1868.—"in Finmarkia Altensi ad jugum inter Nalganas & Spjerkojokka."—No typus examined; described as a white-hairy variant of *A. alpinus.*

Astragalus alpestris (of the alps) Bub., Fl. Pyren. 2: 516. 1900, based on *Astragali*

Map No. 2. Canada and parts of United States. Range (in America) of *A. alpinus*:

nus; and ◢◣ var. *Brunetianus*.

species Rauwolfii Gessn., Op. Bot. ed. Schmiedel, Tab. Lign. No. 15, fig. 127. 1751.—Holotypus, Gessner's somewhat crude but recognizable woodcut!

Phaca astragalina fma. *occidentalis* (western) Gand. in Bull. Soc. Bot. Fr. 48: xviii. 1902. —"Colorado, ad Como, Park Co., alt. 9800 ped. (C. Crandall). Wyoming, ad Green Top (Nelson exs. no. 3263); Montana ad Yellowstone Park, alt. 9000 ped. (Rydberg); Idaho (Heller); New Mexico in alpinis (Wooton)."—Lectotypus, collected at Como, Park Co., Colorado, July 23, 1897, *Crandall,* LY!—Spms. from Como dated August, 1895, *Crandall 896,* NY, US, WIS, are possibly isotypi.

Astragalus alpinus fma. *arctica* [sic] Sond. in Svensk. Bot. Tidsk. 1 (1907): 233. 1908. —No locality given; no typus examined.

Astragalus andinus Jones, Rev. Astrag. 137. 1923, the name taken from *Phaca andina* (of the Rocky Mountains or northern Andes) Nutt. in herb. & ex T. & G., Fl. N. Amer. 1: 345. 1838, in syn.—"Alpine summits of the Rocky Mountains, near the confines of perpetual snow (Thornburg's Pass), about latitude 43°, *Nuttall.*"—Lectotypus, labeled by Nuttall *"Phaca *andina.* In the perpetual snow line of the R. Mts. sources of the Shoshone.," NY! isotypus, from "Thornburg's Pass," BM!

Astragalus alpinus var. *parvulus* (smallish) Rouss. in Contrib. Lab. Bot. Univ. Montréal 24: 23. 1933.—"Bowdoin harbor, Baffin Land, June 10, 1922, MacMillan Expedition. *Ralph Robinson 15* (type: Gray herbarium)."—Holotypus not found at GH in 1960.—*A. alpinus* fma. *parvulus* (Rouss.) Rouss. in Le Nat. Canad. 69: 238. 1942.

Astragalus alpinus subsp. *alaskanus* (of Alaska) Hult., Fl. Alaska & Yukon 1082. 1944. —"... specimens from the interior and Seward Peninsula..."—No typus designated, but 15 collections at NY, US, cited by Hultén, were examined.—*A. alpinus* var. *alaskanus* (Hult.) Lepage in Amer. Midl. Nat. 46: 757. 1951.

Astragalus alpinus fma. *Lepageanus* (Rev. Ernest Lepage, 1905–) Rouss. ap. Lepage in Le Nat. Canad. 77: 230. 1950.—"Québec: Rivières aux Mélèzes (57° 41′ N., 69° 32′ W.), plage sablonneuse, 11 août 1945, *Dutilly & Lepage 14631* (TYPE, Herbier Marie-Victorin, Univ. Montréal)."—Holotypus not examined; described as a minor mutation with glabrous calyx and pod.

Astragalus alpinus var. *alaskanus* fma. *albovestitus* (white-clad) Lepage in Amer. Midl. Nat. 46: 758. 1951.—"Bering Strait Distr.: Kotzebue, *Lepage 25410,* Aug. 11, 1949."—Holotypus LCU!

The Austrian botanist Nicholas Jacquin (*Collectanea* 1: 323. 1786) neatly described the alpine milk-vetch as "gratissimus semper, et quia natura tenellus et quia adspectu decorus"; it is indeed an ever delightful, pretty but unassuming plant which speaks to the plant geographer of high, cool, and northern places. Wherever one may come upon it in its extensive range over arctic tundra and down through the mountains of the Northern Hemisphere, he will recognize the alpine milk-vetch by its slender, freely branching subterranean caudex, connate stipules, nodding flowers of characteristic shape, and by the pendulous, stipitate, trigonous but dorsally grooved pod pubescent nearly always with mixed black and white hairs. Typical var. *alpinus* is so well and widely known that it has seemed superfluous to cite representative material which may be found in plenty in all the larger herbaria of Europe and North America. In America the alpine milk-vetch is often sympatric and sometimes confused with forms of *A. Robbinsii,* a species similar in coloring and choice of habitat but easily distinguished by its superficial and determinate root-crown at the level of the soil, large, veiny, lower stipules, and a pod which is sometimes trigonous but only flattened and not sulcate dorsally. Care must also be taken to discriminate between *A. alpinus* and two dwarf species of *Oxytropis,* in Europe *O. lapponica* (Wahlenb.) Gay and in America *O. deflexa* var. *foliolosa* (Hook.) Barneby, which are not only similar in superficial appearance but not uncommonly found growing with it. The beaked keel, of course, distinguishes *Oxytropis* as a genus, and *O. deflexa* differs further by its free stipules and pod semibilocular by intrusion of a funicular flange and not by a true septum.

The alpine milk-vetch, in spite of its immense range, is not a highly variable species. The foliage is commonly green and thinly pubescent, but may be canescently hirsutulous, a phase known from scattered stations in America from Colorado to the Yukon Valley. The variation in stature and in the relative proportions of the petals has been analyzed from the point of view of the Alaskan flora by Hultén, who proposed for the relatively rank-growing, perhaps polyploid plant of the far Northwest (and probably of the Rocky Mountains) a subsp. *alaskanus* differing from subsp. *alpinus* in its elongate raceme of flowers with keel shorter than rather than equaling the banner and with narrow wings. However even in the Alps of Europe the wings of *A. alpinus* may vary from 1.4 to 3.4 mm. in width, with a variation of over 1 mm. recorded from plants mounted as parts of one collection, and this feature clearly has no systematic significance of itself. In Europe also the banner varies from at least 0.5 mm. shorter to 1 mm. longer than the keel. In the Rocky Mountains an elongate raceme, common in

America but found only rarely in Europe, is not correlated with a keel short in proportion to the banner, nor with narrow wings. Not only are there short and long (more or less than 4 cm.) racemes in the same population, but the wings vary in the longer type from 0.8–3.2 mm. in width and the keel varies in the same group of plants from 0–2 mm. shorter than the banner. In North America, northward along the Cordillera from western Wyoming, *A. alpinus* is common in the timber belt and quite variable in stature and length of the racemes. Plants luxuriating in moist soil along brooks overhung with thickets of willow and shrubby cinquefoil, or on gravel bars of mountains torrents, as also in drier soils of lodgepole pine or aspen forest, tend to be drawn out, broad-leaved, and loosely flowered. But wherever a population of this sort, which corresponds closely to subsp. *alaskanus* Hult., passes directly and continuously out of moist shade onto a dry turfy bank or sunny exposure, the more compact growth-habit generally associated with the European plant is immediately regained. The subsp. *alaskanus* seems to be based on an arbitrarily selected series of relatively tall and lush specimens which even in Alaska and Yukon (cf. Hultén, 1944, maps 813, 813a) lack the geographic segregation which is normally expected of a subspecies.

A second variant of *A. alpinus,* possibly of greater racial importance since it is confined to the highest latitudes around the pole, has been described as *A. arcticus* Bge. It was maintained by Gontscharov as a distinct species under the epithet *subpolaris,* and recognized by Hultén (1944, 1. c.) as a subspecies coordinate with subsp. *alaskanus.* Bunge distinguished it from *A. alpinus* because of its regularly graduated, more richly colored petals, supposedly correlated with a more robust habit of growth. Gontscharov (op. cit. 40, in clave) brought out a further contrast between a fully bilocular pod in *A. alpinus* and a semibilocular one in *A. subpolaris.* About forty collections (over thirty from America) have been seen which would be referred to *A. subpolaris* because the wings surpass the keel in length. By no means all of these have bright purple flowers, and at least in America a flower of this type is not correlated with a relatively narrow septum. In Alaska the plants most closely resembling *A. arcticus* of Novaya Zemlya and northern Lapland are found chiefly along the north coast eastward from Behring Strait, but technically inseparable forms occur in the interior up to 3500 feet elevation. Hultén's map (1944, no. 813b) shows correctly that the subsp. *arcticus* and *alpinus* are sympatric even at their northernmost limits, but leaves out the many puzzling specimens which fail to satisfy the criteria of proportions and coloring of the petals and cannot be considered typical of either subspecies. Such plants as *Coville & Kearney 744* (US) with ample, brightly colored flowers but wings shorter than the keel, or *A. E. Miller in 1919* (US) with small, pale flowers and wings longer than the keel, are real obstacles to recognition of distinct subspecies in Alaska. Hultén (1. c.) cites subsp. *arcticus* as extending east to Baffin and Labrador, but I have seen no material of the extreme type from east of Hudson Strait (*A. P. Low 22,863,* NY). Specimens near *A. arcticus* as ideally conceived have been collected as far south as Thunder Bay District, Ontario (*Taylor & al. 679,* GH), and these are particularly suggestive of an individual, independent variant not genetically linked to the arctic type. The differential characters are quite feebly correlated, and it seems preferable to regard *A. arcticus* as a minor variant. It should be added that the names applied to *A. arcticus* Bge. are all based on *Phaca lapponica* sensu DC., non Wahlenberg, of which a lectotypus has been designated above. Bunge's interpretation of DeCandolle's intention is here followed, but it should be remarked that DeCandolle cited Table 51 of Oeder's *Flora Danica* as illustrating his species. The figure clearly shows wing-petals surpassed by a broad and prominent keel and seems to be a superlatively accurate portrait of *A. alpinus* sens. str.

Although *A. alpinus* seems to be most variable, at least in America, north of about lat. 60° N., there is some evidence also of incipient or possibly reliquial racial differentiation in the Rocky Mountains. In this region the relative proportons of the flower parts remain rather constant, but the whole flower varies considerably in size. With very few exceptions the populations found between the Medicine Bow Range in southern Wyoming and the Sangre de Cristo massif in northern New Mexico are perceptibly smaller-flowered than those occurring northward from the Wind River Mountains. It seems probable that the saddle in the Cordillera corresponding with the Red Desert has been as significant a barrier to *A. alpinus* as to many other plant species. The following figures (in mm.), prepared from over two hundred dissections, illustrate the prevailing differences.

Rocky Mountains from southern Wyoming to northern New Mexico	Western Wyoming to Alaska, Labrador, and Eurasia
Calyx (3.2) 3.4–4.6 (4.8)	(4) 4.4–6.6
tube 2.2–3 × 1.3–2.6	(2.4) 2.7–4 × 2.3–3.7
teeth 0.9–1.8 (2)	1.4–2.8 (3)
Banner (6.2) 7.4–10 (10.5)	(9.5) 10.4–13.6 (14.8)
Wings 7.1–9 (9.8)	(8) 9–12 (13.1)
Keel (7) 7.4–10 (10.5)	9–12.5 (12.7)

The existence of two forms native to the Rocky Mountains is not an altogether new idea. Sheldon distinguished (1894, p. 154, as *A. astragalinus*) genuine *A. alpinus,* which he recognized in America only from Colorado and Labrador, from a larger-flowered *A. giganteus* (Pall.) Sheld.[8] native to the northern Rocky Mountains and equivalent to subsp. *alaskanus* Hult. Under var. *Brunetianus* below, attention is drawn to the similarity in the flower between that variety and the Colorado variant of var. *alpinus.* It seems possible that the two forms are descended together from *A. alpinus* as it existed at the front of the ice sheets during the Pleistocene glaciations. It would not be remarkable if this precursor stock had handed down a small flower which remained unaltered, while the progeny differentiated on other lines into an eastern (var. *Brunetianus*) and a Cordilleran (Colorado) race. The larger-flowered *A. alpinus* could represent a secondary invasion southward from the northern refugia along the Rocky Mountains which reached a dead end at the Red Desert. The form of *A. alpinus* isolated on lake shores in Bayfield County, Wisconsin, appears from the flower-size to be an immigrant from the north.

3b. Astragalus alpinus var. Brunetianus

Like var. *alpinus,* but on the average taller, the stems above ground 1.5–3 (4) dm. long, the herbage green, thinly strigulose or subvillosulous with straight or nearly straight hairs up to 0.35–0.55 mm. long, the leaflets commonly glabrous above, rarely puberulent; *leaflets* 13–23 (25), narrowly elliptic, elliptic-oblanceolate, or (especially in some lower leaves) oblong-ovate or suborbicular, all usually minutely notched, sometimes entire and then either rounded or subacute at apex, 3–14 (18) mm. long; *peduncles* 5–13.5 cm. long, mostly longer than the leaf; *racemes* (4) 7–14 (18)-flowered, the axis 1–3.5 (4.5) cm. long in fruit; *calyx* 3.2–4.4 mm. long, the tube 2–2.9 mm. long, 1.8–2.7 mm. in diameter, the teeth 1–1.8 mm. long; *banner* 9.8–11.8 mm. long, 5.4–7.1 mm. wide; *wings* (0.3–1.8 mm. shorter than the keel) 8.3–10.8 mm. long, the claws 2.9–3.7 mm., the blades 6.7–8.7 mm. long, 1.5–2.5 mm. wide; *keel* 9.1–11.3 mm. long, the claws 3.1–4 mm., the blades 6–8.5 mm. long, 2.5–3.6 mm. wide; *ovules* 7–9 (10); *seeds* pale yellowish- or reddish-brown, smooth, dull, 1.9–2.5 mm. long—Collections: 36 (o); representative: *K. K. Mackenzie 3382* (NY, US), *3383* (NY, pod subglabrous); *J. R. Churchill* (from Aroostook Falls, New Brunswick) *in 1901* (NY, US) *Eggleston 2983* (CAS, NY, US); *Marie-Victorin & al. 16,115* (US), *16,118, 16,119,* (NY); Eggleston from Sumner's Falls, New Hampshire) *in 1894* (NY, US), *in 1898* (CAS).

Rocky shores, ledges near high water, gravel bars in running streams, sometimes inundated by spring freshets or daily by high tide, on schists, sandstones, and limestones, 0–600 feet, locally common in scattered stations: Exploits River, Newfoundland; Lake St. John and estuary of the St. Lawrence River (from Cap Rouge, just above the Ile d'Orléans, downstream to Saguenay County), Quebec; lower Restigouche River, Quebec and New Brunswick; upper St. John River and immediate tributaries, northern Maine and New Brunswick; middle Kennebec Valley (near Waterville), Maine; and along the Connecticut River in Vermont and New Hampshire; reported, apparently by false assumption from the epithet *labradoricus,* from Labrador; to be sought on the coast of Maine (cf. *Rev. J. Blake in 1864*, NY).—Map No. 2.—May to August.

Astragalus alpinus var. Brunetianus (Rev. Louis Ovide Brunet, 1826–1877, early Canadian botanist, of Laval University) Fern. in Rhodora **10**: 51. 1908.—"Type collected on gravelly shores, Fort Fairfield, Maine, July 18, 1893 (*Fernald,* No. 24)."—Holotypus, GH! isotypi, ND, NY, P, US!—*A. Brunetianus* (Fern.) Rouss. in Contrib. Lab. Bot. Univ. Montréal 24: 30. 1933.

Astragalus secundus (secund, of the raceme) Mchx., Fl. Bor.-Amer. **2**: 66. 1803.—"Hab. in septentrionalibus Canadae."—Holotypus, from "Malbaye, Lac St. Jean," P (herb. Mchx.)!

[8]This name, a later homonym (not *A. giganteus* Wats., 1882), is based on *A. alpinus* var. *giganteus* Pall. and is a taxonomic synonym of the Old World *A. norvegicus* Grau.

isotypus, NY (fragm.)! *A. labradoricus* (of Labrador, a geographical error) DC., Prod. 2: 287. 1825, a legitimate substitute (non *A. secundus* DC., 1802). *Atelophragma labradoricum* (DC.) Rydb. in Bull. Torr. Club 55: 131. 1928. *Astragalus alpinus* var. *labradoricus* (DC.) Fern. in Rhodora 39: 315. 1937.

Astragalus labradoricus fma. *albinus* (albino, a white-flowered form) Rouss. in Contrib. Lab. Bot. Univ. Montréal 24: 26. 1933.—"Berthier-en-bas, comté Montmagny, 13 août 1925 (*Jacques Rousseau, 20849*). Type dans l'herbier de l'Université de Montréal)."—Holotypus not seen; described as a white-petaled form.

The var. *Brunetianus* is extremely close to the form of var. *alpinus* prevalent in the southern Rocky Mountains, and it is almost impossible in the absence of labels to distinguish some flowering specimens from Vermont and Colorado. Fernald, in the original description of the variety, and Robinson & Fernald (1908, p. 516) included the Rocky Mountains in the range of var. *Brunetianus*. The small calyx of the eastern variety can be matched exactly in many Colorado specimens of var. *alpinus*, and while the range of petal-length is not exactly the same in the two areas, for the flowers of var. *Brunetianus* are on the average a little longer, there is a wide overlap in all measurements. Thus it seems that the length of the hairs on the pod is the one reliable differential character distinguishing the two. Up to 0.4 mm. long and almost always appressed in var. *Brunetianus*, the hairs are at least slightly longer and nearly always loosely ascending in the southern Cordilleran populations of var. *alpinus* with similarly small calyx. Plants of var. *Brunetianus* with spreading pod-hairs up to 0.4 mm. long have been collected on Murray Bay in the St. Lawrence estuary, and a fruit detached from one of these would pass anywhere for genuine var. *alpinus*. It is impossible therefore to admit *A. labradoricus* to specific rank.

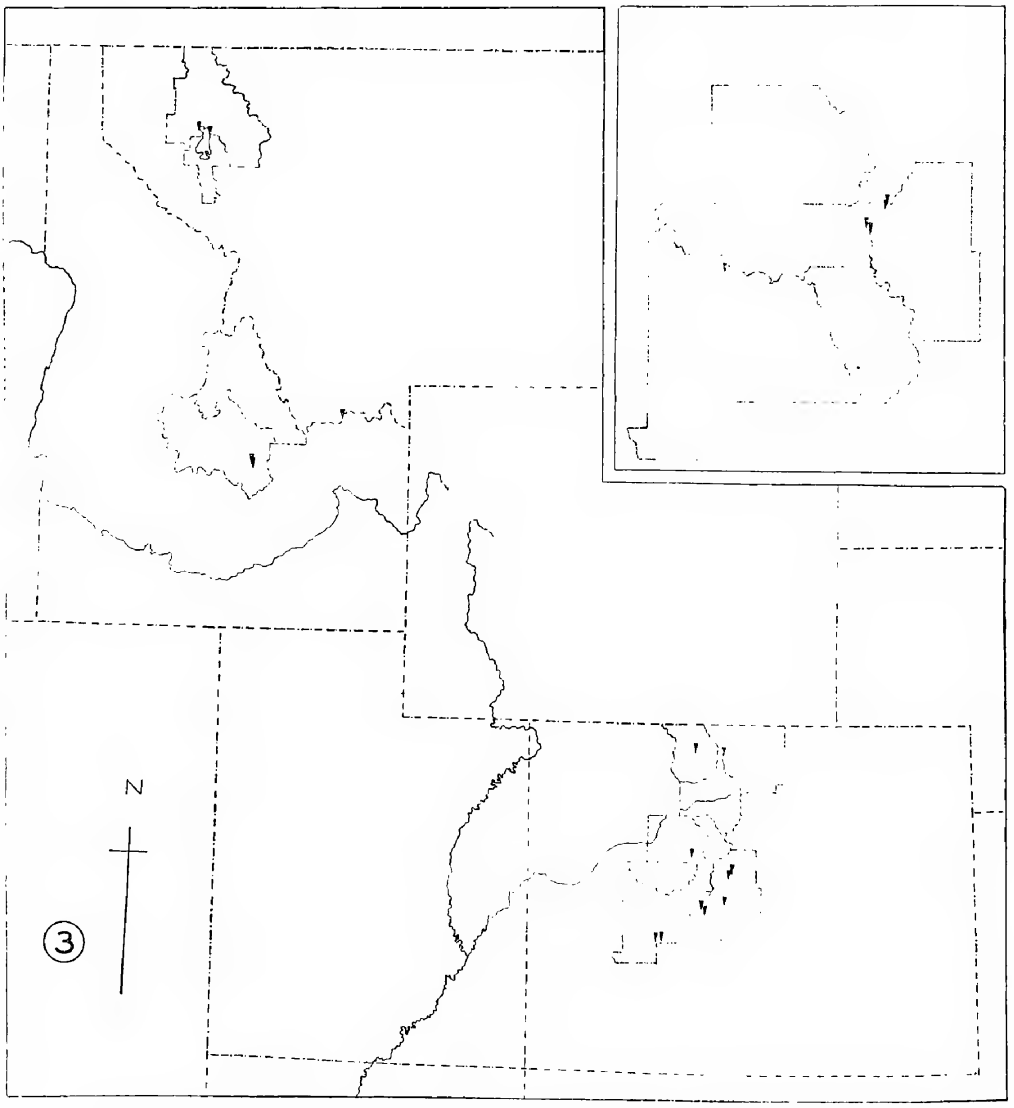
In his Revision of Astragalus in Quebec, Rousseau (1933, passim) separated the riparian and estuarine forms of *A. alpinus* as distinct species, *A. labradoricus* of Newfoundland, Lake St. John, and the St. Lawrence estuary, and *A. Brunetianus* confined to Gaspé, adjoining New Brunswick, and northern Maine. The differential characters stressed in Rousseau's key are, for the first, wing-petals relatively broad (2–2.5 mm.) and pod straight, oblanceolate, and inflated; and for the latter, narrower wings (1.5 mm.) and an incurved, somewhat flattened pod. It has been found, however, that the wings vary from 1.5 to 2.5 mm. wide in plants from the lower St. Lawrence and reach a width of at least 2.2 mm. in the area of *A. Brunetianus*. In the centennial edition of Gray's Manual, Fernald (1950, p. 910) maintained the two entities as varieties to *A. alpinus*, and reduced the supposed differences to outline and curvature of the fruits. These differences are extremely tenuous. It is true that in Quebec the ordinarily collected pod is straight or nearly so and broadest above the middle (cylindro-oblanceolate); in New England it varies from lunately incurved to nearly straight and tends to be broadest near the base (lance-cylindric). Along the Connecticut River the pod is often nearly straight and exactly linear-oblong in profile, with the sides precisely parallel. Variation of this sort must be expected from one population to another when these occupy, as is the case with var. *Brunetianus*, mutually isolated ecological niches. Moreover the variation is no greater than that found in some single populations of var. *alpinus* in the Rocky Mountains. I must add that the pod of Michaux's *A. secundus* preserved in the Torrey herbarium (NY) is distinctly curved.

Along the rivers of New England var. *Brunetianus* is found on rock ledges and stony banks just above the normal high-water line, and sometimes on gravel bars inundated during flood. It is associated in northern Maine and New Brunswick with *A. eucosmus*, and along the Connecticut River with *A. Robbinsii* var. *Jesupi*, both species of boreal and Cordilleran affinity. The remarkable ecology of var. *Brunetianus* in the intertidal zone of the St. Lawrence estuary has been described at length by Rousseau (1933, p. 26, sequ.).

4. Astragalus leptaleus

Weak, delicate, diffuse, with a slender taproot and widely branching subterranean caudex, thinly strigulose with fine, straight, appressed hairs up to 0.2–0.5 mm. long, the stems and herbage bright green, the leaflets glabrous above, the inflorescence commonly nigrescent; *stems* loosely tufted, in old plants very numerous and entangled, 5–20 (30) cm. long, arising singly or few together from buds on the slender, buried caudex-branches, branched at the first emersed, usually congested nodes, floriferous upward from near or from well below the middle; stipules 2–5 mm. long, thinly herbaceous or submembranous, usually several-nerved, the lowest becoming papery in age, all glabrous dorsally, fully amplexicaul and connate, the lowest into a short bidentate sheath, the upper ones longer,

united through half their length or less, sometimes only at very base, with lanceolate free blades; *leaves* 2.5–10 cm. long, petioled but the uppermost shortly so, with subfiliform rachis and (9) 15–23 (27) narrowly elliptic or lanceolate and subacute, or (in the lower leaves) often ovate and obtuse, thin-textured leaflets 3–15 mm. long; *peduncles* filiform, ascending, 2–5.5 cm. long, shorter than the leaf; *racemes* loosely 1–5 (commonly 2- or 3-)-flowered, the flowers ascending at anthesis, declined thereafter, the axis up to 1 cm. long in fruit; *bracts* membranous, lanceolate or lance-ovate, 1.3–3.3 mm. long; *pedicels* at anthesis straight, 1.2–2.1 mm. long, in fruit arched outward, 1.4–2.5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 4–5.7 mm. long, densely to quite thinly black- or rarely white-strigulose, the somewhat oblique disc 0.3–1 mm. deep, the campanulate tube 2.7–3.4 mm. long, 1.9–2.4 mm. in diameter, the subulate or lance-subulate teeth 1.1–2.5



Map No. 3. Left, the Rocky Mountain States. Range of *A. leptaleus*. Top right, the Continental Divide in central Colorado. (Eagle, Pitkin, Gunnison, Park, and Chaffee Counties). Range of *A. molybdenus*.

mm. long; *petals* white (sometimes "purplish" fide Jones), the keel-tip maculate with dull bluish-purple; *banner* recurved through ±45°, ovate-cuneate, notched, 8.5–11.8 mm. long, 4.8–7.2 mm. wide; *wings* 7.2–9.5 mm. long, the claws 2.7–3.8 mm., the obliquely obovate, oblong-oblanceolate or -elliptic, obtuse or emarginate blades 4.9–6.5 mm. long, 1.8–2.9 mm. wide; *keel* 6–7.3 mm. long, the claws 2.8–3.9 mm., the obliquely half-obovate blades 3.2–3.9 mm. long, 1.8–2.3 mm. wide, incurved through 85–120° to the bluntly deltoid apex; *anthers* 0.3–0.5 mm. long; *pod* pendulous, obscurely stipitate or subsessile, the stipe not over 1.5 mm. long, often reduced to a narrow neck, the body oblong-, lance-, or subclavate-elliptic in dorsiventral view, 8–14 mm. long, 2.5–4 mm. in diameter, slightly decurved, shortly subulate- or cuspidate-beaked, obcompressed and bluntly trigonous, with obtuse lateral angles and low-convex lateral faces, keeled ventrally by the prominent, convexly arched suture, flattened or shallowly and openly sulcate dorsally, the thin, green, sparsely black- or white-strigulose valves becoming stramineous and papery, not inflexed; *ovules* 6–10; *seeds* (seldom observed) brown, smooth, lustrous, ± 1.8–2.1 mm. long.—Collections: 20 (iii); representative: *J. & C. Christ 17,865* (ID, NY, RSA); *Jones* (from Monida, Montana) *in 1922* (CAS, NY, POM); *Hall & Harbour 141* (GH, NY, OXF, P); *Ripley & Barneby 7180* (CAS, GH, NY, RSA, UTC); *W. A. Weber 8768* (CAS).

Forming small scattered colonies or running together into extensively matted growths in moist sedgy meadows, along swales, or on turfy hummocks at the edge of meandering brooks, 2800–8700 feet, locally plentiful but uncommon in the cooler valleys and parks of the Rocky Mountains: western Montana (Flathead Lake and about the headwaters of Red Rock Creek); eastcentral Idaho (upper Lost River in Custer County); and Colorado (from upper Laramie River south to South Park, Wet Mountain Valley, and the upper Gunnison River); to be expected in western Wyoming.—Map No. 3.—June to August

ASTRAGALUS LEPTALEUS (slender) Gray in Proc. Amer. Acad. 6: 220. 1864, a substitute for *A. pauciflorus* (Nutt.) Gray in Proc. Philad. Acad. 1863, p. 60. 1863 (non *A. pauciflorus* Pall., 1800, nec. Hook., 1831), based on *Phaca pauciflora* (few-flowered) Nutt. ex T. & G., Fl. N. Amer. 1: 348. 1838.—"Plains of the Rocky Mountains, near streams . . . *Nuttall*"—Holotypus labeled by Nuttall "*Phaca *pauciflora.* R. Mts.," BM! isotypi, GH, K!—*Tragacantha leptalea* (Gray) O. Kze., Rev. Gen. 946. 1891. *Phaca leptalea* (Gray) Rydb. in Bull. Torr. Club 40: 48. 1913.

The park milk-vetch, *A. leptaleus,* is similar to *A. alpinus* in its habit of growth and the nature of its slenderly forking subterranean caudex, but is easily recognized by its few tiny, whitish flowers which are often concealed by the tender, prolific foliage, and subsequently by the subsessile or very shortly stipitate, minutely strigulose, unilocular fruit. In the parks of the Colorado Rocky Mountains it is often associated with *A. Bodini,* but this differs greatly in its determinate superficial root-crown and more numerous flowers of a vivid purple. Being naturally inconspicuous and found only in meadows where showy louseworts and shooting-stars crowd in their thousands through the sedgy turf, *A. leptaleus* is easily overlooked, although sometimes so plentiful locally as to afford a palatable forage. So far as can be learned from dried specimens, the petals, except for the maculate keel-tip, are always white, but Jones (1923, p. 90) describes the flower as rarely purplish. Jones also traces its range south to Santa Fe, New Mexico, and north into Canada, but at least the latter extension (and also, perhaps, the purple flower) is based on old collections of *A. Bodini.*

III. Sectio MINERALES

Low, matted, shortly caulescent perennials, with widely spreading, subterranean caudex; *vesture* basifixed; *stipules* connate; *leaves* imparipinnate, with ± 17–25 leaflets; *flowers* few, shortly or subumbellately racemose, ascending, small, the banner ± 9.5–11 mm. long; *calyx-tube* campanulate; *petals* purple or lilac-tinged, regularly graduated, the keel-tip bluntly triangular; *pod* humistrately

ascending, sessile or nearly so, continuous with the receptacle, obliquely ovoid, subtrigonously compressed, flattened or depressed dorsally, the thinly papery valves not inflexed; *ovules* 6.—Sp. 1, of the tundra zone in the Colorado Rocky Mountains (possibly a second sp. in western Wyoming).

ASTRAGALUS sect. MINERALES, sect. nov., sect. *Astragalo* ut videtur affines, *A. leptaleo* habitu toto et praesertim caudice subterraneolate repenti hinc inde radicanti stipulisque inter se connatis similes sed legumine sessili adscendenti humistrato nec pendulo abhorrentes.—Sp. typica: *A. molybdenus* Barneby.

The sect. *Minerales* is poorly characterized. The typical species was thought at first to be closely akin to *A. alpinus* and *A. leptaleus* of sect. *Astragalus,* but it differs in its humistrately ascending sessile pod. It thus agrees better with sect. *Polares,* save that the fruit is persistent on the receptacle and does not fall away when ripe except with the marcescent calyx and the pedicel. The close ties of the *Minerales* will have to be reconsidered when their cytology has been worked out in relation to that of the morphologically similar arctic-alpine groups of both hemispheres. The typus of sect. *Astragalus, A. alpinus,* belongs to the Old World series with a basic chromosome number of 8, whereas the *Polares* are apparently a homaloboid, that is, a purely American group with $2n = 12$. A curious feature of *A. molybdenus* is the relatively immense size of the seeds.

An astragalus resembling *A. molybdenus* in habit, but with leaflets glabrous on the upper side and a glabrous ovary (5–8-ovulate) has been collected in flower in the Salt River Mountains in western Wyoming (near Cottonwood Lake, east of Smoot, 9500 feet, Lincoln County, July 31, 1923, *Payson & Armstrong 3671,* MO, RM), and when better known may prove to be a second member of sect. *Minerales.*

5. ASTRAGALUS MOLYBDENUS

Low, loosely tufted or matted, with a slender taproot and loosely, sometimes extensively branching subterranean stems persisting as rhizome-like caudex-branches (sometimes adventitiously rooting and thus vegetatively reproductive), the stems above ground thinly strigulose, the herbage thinly to densely strigulose-pilosulous with fine, nearly straight, appressed and ascending hairs up to 0.4–0.5 mm. long, greenish-cinereous to silvery-gray, the leaflets sometimes medially glabrescent above, the inflorescence black-hairy; *stems* of the season largely subterranean, the aerial tips prostrate or weakly ascending, 0.5–6 (14) cm. long, the internodes all short, or a few of them developed and up to 1.5 (4) cm. long, mostly shorter; *stipules* 2–5 mm. long, submembranous, purplish, glabrous dorsally, the lowest becoming pallid and scarious, all amplexicaul and connate through ± half their length, the free blades deltoid or lanceolate, obtuse or subacute; *leaves* 1.5–7 cm. long, petioled, with (9) 17–25 ovate, ovate-oblong, or elliptic, obtuse, mostly crowded, folded or involute leaflets 2–10 mm. long; *peduncles* at anthesis incurved-ascending, procumbent in fruit, 1–3 (6.5) cm. long; *racemes* loosely 3–6-flowered, the flowers loosely ascending, the axis scarcely elongating, 3–10 (15) mm. long in fruit; *bracts* membranous, lanceolate or ovate-acuminate, 2.5–5 mm. long; *pedicels* at anthesis 0.5–1.5 mm. long, in fruit either straight or arched outward, 1–2 mm. long; *bracteoles* 0–2, minute when present; *calyx* 5.2–7 mm. long, densely black-strigulose, the oblique disc 0.5–0.8 mm. deep, the campanulate tube 3–4.2 mm. long, 2.7–3.2 mm. in diameter, the broadly subulate teeth 2–3 mm. long; *petals* pink-purple, dull lilac, or whitish with banner veined and distally suffused with lilac, the keel-tip always maculate; *banner* recurved through ± 45°, ovate-cuneate, notched, 10.7–12.5 mm. long, 5.2–7.2 mm. wide; *wings* 9.3–10.9 mm. long, the claws 3.3–4.4 mm., the oblong-obovate, obtuse, slightly incurved blades 6.6–8 mm. long, 2.5–2.7 mm. wide; *keel* 8.8–9.7 mm. long, the claws 3.8–4.7 mm., the broadly lunate blades 5.3–5.7 mm. long, 2.3–2.8 mm. wide, incurved through 90–100° to the bluntly triangular apex; *anthers* 0.45–0.6 mm. long; *pod* ascending (humistrate), sessile or nearly so, obliquely ovoid or ovoid-ellipsoid, a trifle in-

curved, 7–11 mm. long, ± 3.5 mm. in diameter, rounded at base, abruptly deltoid-beaked and cuspidate at apex, subtriquetrously compressed with acute ventral and rounded lateral angles, flattened or somewhat depressed dorsally but hardly sulcate, the prominent ventral suture either straight or a trifle concave in profile, the thin, submembranous, densely black- or more rarely partly white-strigulose valves not inflexed; *dehiscence* not seen; *seeds* (not seen quite ripe) ± 4.2–4.5 mm. long.—Collections: 11 (iv); representative: *Weber, Rollins & Livingston 6514* (CAS, RM); *Weber & Barclay 9182* (NY); *Langenheim 4029, 4071* (RM, UC); *Ripley & Barneby 10,402* (CAS, NY, RSA).

Turfy hillsides and bare gravelly banks above timber line, sometimes creeping in scree or coarse debris at the foot of rock slides, in moist or summer-dry, well-drained soils, on granitic or shaley bedrock, 11,400–13,000 feet, locally plentiful in the highest Rocky Mountains of central Colorado, about the sources of the South Platte, Arkansas, Gunnison, and Grand Rivers.—Map No. 3.—July to August.

ASTRAGALUS MOLYBDENUS (of lead, from Leadville, Colorado) Barneby in Leafl. West. Bot. 6: 70. 1950, a substitute for *A. plumbeus* (leaden) Barneby in op. cit. 5: 195. 1949 (non *A. plumbeus* Gontsch., 1946).—"COLORADO: . . . about 4 miles east of Leadville, Lake County . . . *Ripley & Barneby No. 9994* . . . west slope of Mosquito Pass, east of Leadville, *No. 10045*."—Cotypi, CAS! isotypi, GH, K, NY, POM, RM, RSA, US, WTU!

The Leadville milk-vetch, *A. molybdenus,* is one of very few astragali found in the tundra zone of the southern Rocky Mountains. On the South Platte-Arkansas divide its altitudinal range overlaps that of *A. alpinus,* a species very common in the timber belt, by a hundred feet or so; it becomes abundant only well above the tree line, especially in stony turf and at the edge of rock slides which it sometimes shares with the arctic-alpine *Oxytropis podocarpa* Gray. In such places *A. molybdenus* forms dense patches of silvery-gray or ashen-green foliage, spreading by slender sucker-like stolons which may give rise at intervals to an independent root system. The Leadville milk-vetch closely resembles the more densely pubescent Cordilleran phases of *A. alpinus* in superficial aspect, but is easily distinguished by its regularly graduated petals and by the sessile, unilocular pod. The habitally similar *A. leptaleus,* a denizen of moist meadows at much lower elevations, differs in its tender green herbage, usually white flowers with a shorter purple-tipped keel, and pendulous, slightly decurved pod.

The first known collection of *A. molybdenus* is one taken by John Merle Coulter on Mt. Lincoln in the Park Range, at 13,000 feet, in the summer of 1873 (NY).

IV. Sectio OROBOIDEI

Caulescent, taprooted perennials, with superficial root-crown; *vesture* basifixed, often scanty, commonly black or fuscous in the inflorescence; *stipules* dimorphic, the lowest (at crowded, leafless nodes) large, obtuse, several-nerved, fully amplexicaul, shortly connate or free, the upper ones narrower, herbaceous, free; *leaves* imparipinnate, with few (7–17), commonly flat, thin-textured, bicolored leaflets, pallid beneath, the deeper green upper surface often appearing minutely pallid-tuberculate when dry; *flowers* loosely or compactly racemose, nodding, in ours small, the banner 5.5–11.5 mm. long; *calyx-tube* campanulate; *petals* purple or purplish, rarely whitish, regularly graduated, the wings obtuse, truncate, or emarginate at apex, the keel-tip obtuse; *pod* deflexed or pendulous, sessile or stipitate, tardily deciduous with the disjointing pedicel, the body plumply to narrowly ellipsoid, straight or slightly decurved, obscurely trigonous or compressed-trigonous, carinate ventrally by the filiform suture, flattened or shallowly depressed dorsally, the thin, papery or papery-membranous valves inflexed as an incomplete, hyaline septum; *dehiscence* apical and downward through the ventral suture, the valves finally opening like the covers of a book; *ovules* (in ours) 3–11.—Spp. ± 7, mesophytes, of northern and arctic Eurasia, montane central Asia, the Caucasus, and North America, 2 with us, widespread from Alaska to Baffin Island, south to

Nova Scotia, New England, and along the Rocky Mountains to Colorado, northeastern Nevada, and northeastern Washington.

ASTRAGALUS sect. OROBOIDEI Gray in Proc. Amer. Acad. 6: 203. 1864, emend. Rydb., 1928, l.c. infra (sub *Atelophragmate*).—Sp. typica: *A. oroboides* Hornem. = *A. norvegicus* Grauer.—*Astragalus* sect. *Oroboideus* Sheld. in Minn. Bot. Stud. 1: 152. 1894, a superfluous substitute. *Atelophragma* sect. *Oroboidea* (Gray) Rydb. in Bull. Torr. Club 55: 128. 1928.

Atelophragma sect. *Robbinsiana* Rydb. in Bull. Torr. Club 55: 124. 1928.—Sp. typica: *A. Robbinsii* (Oakes) Rydb. = *Astragalus Robbinsii* (Oakes) Gray.

Astragalus sect. *Orobella* Gontsch. in Fl. U. R. S. S. 12: 877. 1946.—Sp. typica: *A. oroboides* Hornem. = *A. norvegicus* Grauer.

Psychridium Stev. in Bull. Soc. Nat. Mosc. 4: 265. 1832, & in Nouv. Mém. Soc. Nat. Mosc. 3: 105. 1834, nom. nud. sine descr.

The *Oroboidei* are nearly related to sects. *Hemiphragmium* and *Astragalus*, differing from the first in the obtuse or obliquely emarginate but never bidentate wing-petals and from the second in the determinate, superficial root-crown (thus lacking the slenderly forking, subterranean caudex characteristic of *A. alpinus*). They should perhaps be united with sect. *Hemiphragmium*—there is at least one European member of the latter in which the wings are only emarginate—but the problem of defining these sections involves a number of Asiatic species known to me only from descriptions and cannot be resolved in these pages. The existence of a natural group of *Astragali* exemplified by *A. oroboides* Hornem. and *Phaca brachytropis* Stev. and distinct from sect. *Hemiphragmium* as typified by *A. australis* (L.) Lamk., was recognized as early as 1832 by Christian Steven, but his segregate genus *Psychridium* was only tentatively proposed and not validly published. Several legitimate sectional names exist for the group, the earliest known to me being *Oroboidei* Gray. As originally defined, Gray's *Oroboidei* consisted of three heterogeneous subsections of which only the first, the manifestly typical *Veri, Boreales* need be considered here. Even this subsection was something of a mixture, for it included *A. (Hemiphragmium) aboriginum* and *A. glabriusculus, A.* (genuine *Oroboidei*) *Robbinsii* and *A. oroboides* (this including our *A. eucosmus*), *A. (Astragalus) alpinus,* and the piptoloboid *A. sparsiflorus*. Apart from the last mentioned, certainly misplaced, Gray's *Oroboidei Veri* are precisely equivalent to sect. *Hemiphragmium* as defined by Bunge (1868) or (deprived of the largely Mexican *Strigulosa*) the genus *Atelophragma* Rydb. Subsequently Rydberg and Gontscharov broke up the substance of sect. *Hemiphragmium* sensu Bunge into smaller, more exactly definable units, and it is interesting to find that although they were working primarily with New and Old World species respectively, they reached substantially the same conclusions. Thus Rydberg's sects. *Glabriuscula, Oroboidea* (if merged with the inadequately distinguished *Robbinsiana*) and *Alpina* in *Atelophragma* are essentially the same as sects. *Hemiphragmium, Orobella,* and *Komaroviella* of the Soviet Flora.

The American *Oroboidei* are much alike in habit of growth and details of the flower, and material with fruits at least half formed is generally required for identification.

Key to the American Species of sect. Oroboidei

1. Pod sessile or nearly so, the stipe less than 0.5 mm. long, the body short, (4) 5–13 mm. long ..... 6. *A. eucosmus*
1. Pod stipitate, the stipe 0.5–5.5 mm. long (but less than 1 mm. long only in n.-e. Nevada, where *A. eucosmus* is unknown), the body rarely less than 12 mm. and up to 25 mm. long ..... 7. *A. Robbinsii*

6. ASTRAGALUS EUCOSMUS

Variable in stature but commonly slender, thinly strigulose with fine, appressed or narrowly ascending hairs up to 0.2–0.6 mm. long, the stems and herbage usually green and the leaflets commonly glabrous above, rarely strigulose on both faces, the entire plant rarely subglabrous; *stems* erect or (especially northward) decumbent and incurved-ascending, (0.6) 1–4 dm. long, simple or almost so, leafless and purplish at base; *stipules* (1.5) 3–6 mm. long, dimorphic, the lowest ones approximate or loosely imbricated, broadly ovate, obtuse, early becoming papery and purplish-brown, amplexicaul and wider than the stem, the contrapetiolar margins either free and contiguous or shortly connate, the median and upper ones progressively narrower upward, the uppermost herbaceous, lanceolate or lance-acuminate, acute or subacute, free, often reflexed; *leaves* (2) 3–10 cm. long,

the upper ones subsessile, with 9–15 (17) oblong, lance- or linear-oblong, oblong-obovate, or oblanceolate, obtuse or emarginate, often visibly penninerved, flat or loosely folded leaflets (4) 6–20 (30) mm. long; *peduncles* usually strictly erect and surpassing the leaf, but from diffuse stems incurved-ascending, (3.5) 5–18 cm. long; *racemes* (5) 7–25-flowered, compact at earliest anthesis, narrowly cylindrical but usually quickly elongating, becoming lax and secund, the flowers early declined, the axis mostly (2) 3.5–19 cm., rarely 1–2.5 cm. long; *bracts* submembranous, lanceolate, 1–3.5 mm. long; *pedicels* at anthesis 0.5–2 mm., in fruit recurved or dejected, 0.8–3 mm. long; *bracteoles* 0 (1); *calyx* 3.3–5.4 mm. long, strigulose or pilosulous with black, gray, or rarely white hairs, the disc 0.4–0.8 mm. deep, the campanulate, often purplish tube 2.5–3.5 mm. long, the subulate teeth 0.7–1.9 mm. long, the whole becoming papery, ruptured, marcescent; *petals* purplish, purple-tipped or -margined, pinkish-gray, or whitish, exceptionally white; *banner* gently recurved through ± 40°, oblanceolate to narrowly obovate-cuneate, openly notched, (4.1) 5.5–7.6 mm. long, (2.2) 2.8–3.7 mm. wide; *wings* (4.5) 5–6.3 mm. long, the claws (2) 2.3–3.1 mm., the narrowly oblanceolate or oblong-oblanceolate, obtuse, truncate, or emarginate, nearly straight blades (2.6) 3.2–4.1 mm. long, 1–1.5 mm. wide; *keel* 4–5.7 mm. long, the claws 2.1–2.9 mm., the half-obovate blades 2–3.2 mm. long, (1.1) 1.4–1.8 mm. wide, incurved through 90–100° to the rounded apex; *anthers* (0.15) 0.2–0.35 (0.4) mm. long; *pod* deflexed, sessile or almost so, the stipe (if present) vestigial and less than 0.4 mm. long, the body subsymmetrically or obliquely ovoid-ellipsoid, usually a little decurved (the ventral suture the more strongly convex in profile), (4) 5–13 mm. long, (2.3) 2.5–5.5 mm. in diameter, cuneate at both ends, shortly cuspidate at apex, when ripe a little turgid but obscurely triquetrous, the lateral faces convex, the usually narrower dorsal one flattened, the whole usually wider between the sutures than between the valves (thus compressed-triquetrous) but sometimes the reverse, the rather firmly papery valves densely strigose-pilosulous with black, gray, but commonly mixed black and white, more rarely mostly, exceptionally all white hairs up to 0.2–0.5 mm. long, inflexed as a hyaline septum (0.2) 0.4–1.2 mm. wide; *ovules* 4–8, commonly 6; *seeds* brown, smooth, 1.5–2.2 mm. long.—Collections: 122 (ii); representative: *Viereck 1751* (COLO); *Eastwood 469* (CAS, US, WS); *Porsild & Breitung 10,825* (US); *Cody & McCanse 3255* (CAS); *Calder & Gillett 25,376, 25,421, 25,739, 26,376* (NY); *J. M. Macoun 59,846* (NY); *Macoun & Herriott 70,485* (NY); *Marie-Victorin & al. 44–157* (CAS, TEX, WS); *Fernald & al. 28,591, 28,594* (GH, NY); *Rouleau 497* (US); *C. L. Hitchcock 16,767* (NY, RSA, WS); *Suksdorf 302* (NY, WS); *L. & R. Williams 3182* (NY, WS, WTU), *3331* (CAS, NY, WS); *E. & L. Payson 2014* (CAS, NY); *Ripley & Barneby 10,532* (CAS, RSA).

Stream banks and shingle bars, often about willow thickets or with shrubby cinequefoil, in aspen groves, open spruce or fir forest, sometimes in meadows moist in spring, at high latitudes on dry but cool, turfy banks and shores, without apparent rock preference, from sea level northward up to 10,500 feet in the Rocky Mountains, widespread in scattered stations from western Alaska to Baffin Island, south to Newfoundland and northern Maine, and along the east slope of the Rocky Mountains to the headwaters of the South Platte in Colorado; also extending feebly westward across the Continental Divide to the Selkirk Range in southern British Columbia, to the edge of the Snake River drainage in eastern Idaho (Fremont County), and to the headwaters of the Bear River in the Uinta Mountains, Utah.—Map No. 4.—Late May to August.

ASTRAGALUS EUCOSMUS (becoming) B. L. Robins. in Rhodora 10: 33. 1908, based on *A. oroboides* var. *americanus* (American) Gray in Proc. Amer. Acad. 6: 204. 1864 (non *A.*

Map No. 4. Canada and United States. Range of *A. eucosmus*.

americanus (Hook.) Jones, 1898), based in turn on *Phaca elegans* (neatly pretty) Hook., Fl. Bor.-Amer. 1: 144. 1831.—"Prairies of the Rocky Mountains . . . *Drummond.*"—Holotypus, K!—*Astragalus elegans* (Hook.) Sheld. in Minn. Bot. Stud. 1: 154. 1894, a later homonym of *A. elegans* Bge., 1869. *Atelophragma elegans* (Hook.) Rydb. in Bull. Torr. Club 32: 660. 1905.

Phaca parviflora (small-flowered) Nutt. ex T. & G., Fl. N. Amer. 1: 348. 1838 (non *A. parviflorus* Lamk., 1783).—"Vallies of the Rocky Mountains . . . *Nuttall.*"—Holotypus, labeled by Nuttall "*Phaca *parviflora.* R. Mts.," BM! isotypi, K, NY, PH!—*Astragalus elegans* var. *curtiflorus* (short-flowered) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 242. 1900. *A. curtiflorus* Rydb. ex Jones, Contrib. West. Bot. 10: 64. 1902, an error, corrected by Jones on p. 87 of the same signature published the same day, hence illegitimate because not unequivocally accepted by the author.

Phaca oroboides fma. *americana* (American) Gand. in Bull. Soc. Bot. Fr. 48: xvii. 1902. —"Hab. Colorado et Wyoming simul, ad North Park, alt. 8500 ped. (G. Osterhout)."—Holotypus, labeled "North Park, on edge of Wyoming, July 25, 1898," *Osterhout,* LY! sheets numbered *Osterhout 1065,* RM, and dated July 24, 1898, WIS, are probably isotypi.

Astragalus eucosmus fma. *albinus* (albino) Fern. in *Rhodora* 28: 215. 1926.—"NEWFOUNDLAND: . . . base of Ha-Ha Mountain, Ha-Ha Bay, July 17, 1925, *Fernald, Wiegand, Gilbert & Hotchkiss,* no. 28,588 . . . "—Holotypus, GH!

Astragalus eucosmus var. *facinorum* (of exploits) Fern., l.c. 1926.—"NEWFOUNDLAND: . . . north bank of Exploits River below the falls, Grand Falls, July 3, 1911, *Fernald, Wiegand, Bartram & Darlington,* no. 5795 . . . "—Holotypus, GH! isotypus, NY!

Atelophragma atratum (blackened, of the dark pubescence) Rydb. in N. Amer. Fl. 24: 372. 1929.—"Type collected August 22, 1896, on Herchel Island, Yukon, *Alvin Seale* . . . "—Holotypus, DS!—*Astragalus Sealei* (Alvin Seale, 1871–1958, distinguished ichthyologist, creator and director of Steinhart Aquarium at CAS) Lepage in Le Nat. Canad. 85: 102, fig. z (phototypus). 1958, a legitimate substitute (non *A. atratus* Wats., 1871).

Astragalus eucosmus var. *terrae-novae* (of Newfoundland) Rouss. in Contrib. Lab. Bot. Univ. Montréal 24: 43. 1933.—" . . . nord-ouest de Terre-Neuve: Burnt Cape, July 17, 1925 *(Fernald & al. 28594);* Pistolet Bay, July 18, 1925 *(Fernald & al. 25595);* id., specimen en fleurs (*25596*: type, Gray Herbarium . . .); id., specimen en fruits, Aug. 11, 1925 *(Fernald 25591*: cotype, Gray Herbarium . . .)."—Cotypi, GH!

Astragalus eucosmus fma. *villosus* (softly hairy) Rouss. in op. cit. p. 44. 1933.—"Terre-Neuve: Ha-Ha Mountains, July 17, 1925 *(Fernald & al., 28,589);* Ha-Ha Point, Aug. 5, 1925 *(Fernald & al. 28590)* . . . "—Cotypi, GH!

Astragalus eucosmus fma. *caespitosus* (tufted) Rouss., l.c. 1933.—"Terre-Neuve: Bay of Island, Aug. 12, 1925 *(Fernald & al., 28592).*"—Holotypus, GH!

Astragalus eucosmus fma. *leucocarpus* (with white pods) Lepage in Amer. Midl. Nat. 46: 758. 1951.—"Alaska Range Distr.: Richardson Highway, Mile 150, *Lepage 23155,* June 14, 1948 . . . "—Holotypus, LCU!

The elegant milk-vetch, *A. eucosmus,* is closely related to *A. Robbinsii,* differing chiefly in the sessile pod. The leaflets tend to be narrower and the flowers are often a little smaller, but neither of these features is diagnostic of *A. eucosmus* and fruits at least half formed are often necessary for identification. From the viewpoint of a narrow and inflexible logic it would be possible to append *A. eucosmus* to the collective species *A. Robbinsii,* regarding it as the culminating point in a series marked by ever shorter stipe and body of the pod; for as far as the fruit alone is concerned, the morphological gap between the elegant milk-vetch and *A. Robbinsii* var. *Fernaldii* or var. *occidentalis* is hardly greater than that between some other varieties of the *A. Robbinsii* complex. However the several races of *A. Robbinsii* occupy vicariant, mutually exclusive ranges of dispersal, only one of them at all far-flung, the remainder consisting of one or at best a few populations of an obviously relict character. The range of *A. eucosmus* is similar in general type and in many details to that of the whole collective species *A. Robbinsii.* In Labrador it is sympatric with *A. Robbinsii* var. *Fernaldi;* in the Rocky Mountains it is sometimes directly associated wth var. *minor;* and in Alaska it overlaps var. *Harringtonii;* yet in all these far distant places it maintains its integral individuality. Apparently *A. eucosmus* had already reached a terminal evolutionary stage before the last Pleistocene glaciations, while the largely sympatric *A. Robbinsii* has continued to undergo modification since its continuous range was broken up by the ice.

Despite its great range *A. eucosmus* is only moderately variable, much less so than a glance at the long synonymy might suggest. Normally an erect plant of moderate stature, it is susceptible to dwarfing in open montane and far northern environments, where the stems become diffuse or weakly ascending as well as shorter, and the raceme tends to become shorter and more compact in fruit. The extensive series of specimens collected in Newfoundland by

Fernald and associates beautifully illustrates a gradual passage from a tall plant with long, narrow racemes precisely matching the common Cordilleran type into a low ecotype with short, diffuse stems and more or less shortened racemes from wind-blown barrens by the sea. A diminutive specimen from Hudson Strait (Wakeham Bay, *Polunin 1548,* US) with stems only 6 cm. long and racemes reduced to about seven flowers exemplifies the extreme in this direction. Rousseau's fma. *caespitosus,* var. *terrae-novae* (admittedly no more than a "forme écologique") and fma. *minor* (excluding the basonymic *Phaca elegans* β *minor* of Hooker) are minor variants of no taxonomic value. Both in eastern Canada and in the Rocky Mountains there is some variation in density and distribution of the pubescence, the leaflets varying from glabrous to sparsely pubescent (fma. *villosus*) above, and the lower surface from green to cinereous. An unusual plant with almost glabrous foliage and glabrous (or in the isotypus at NY nearly glabrous) calyx was distinguished as var. *facinorum,* but Fernald seems deliberately to have omitted mentioning that he collected in the type-locality only eight days later a perfectly normal example of *A. eucosmus (Fernald & al. 5796).* The hairs on the calyx and pod vary from black or fuscous to white, but are nearly always of mixed color. The proportion of light to dark hairs varies from plant to plant in a colony, sometimes even from pod to pod on a given plant, but the rare cases of concolorous pubescence, whether black or white, are only the termini of a continuous series of negligible variants.

The raceme of *A. eucosmus* ordinarily elongates rapidly during anthesis, the axis becoming about 3.5–19 cm. long in fruit with pods well spaced along its length. Instances of shortening have been mentioned already, but these are correlated with short, diffuse stems and an unfavorable habitat, mostly on exposed seashores at high latitudes in eastern Canada and Baffin. In central and northern Alaska, extending from McKinley Park west to Seward Peninsula and to the arctic slope of the Brooks Range (and just into Yukon), there occurs a remarkable, possibly distinct form in which a compact fruiting raceme is found on comparatively tall, erect stems, sometimes associated with broad leaflets of membranous texture and a sylvan or protected streamside habitat. In these plants, or many of them, it is not possible to attribute the shortening of the raceme to environmental factors; it is apparently inherited, and when (as often) the compact raceme is correlated with extremely small flowers and small pods only (4) 5–8 mm. long, the superficial appearance is striking. A specimen of this type from Arctic Yukon was described by Rydberg as *Atelophragma atratum,* and the proposition (amplified by a collection from the Alaska Range, *Dutilly, Lepage & O'Neill 21,611,* DAO) has recently been accepted by Lepage under the new name *A. Sealei.* Other representative examples are *Scamman 5559* (GH); *G. H. Ward 1362* (GH, US); *Chambers 229* (GH, US); *Mexia 2031* (MO, p.p.); *Newsom* (from Sable Pass) *in 1930* (POM); and *Galen Smith 2201* (ALA, UC), the last being the mesophytic extreme from the shade of willows along a brook at 2200 feet in the Alaska Range (which I prematurely annotated as an undescribed species). The general aspect of *A. Sealei* is that of a small-flowered version of *A. norvegicus,* the Eurasian analogue of *A. eucosmus,* and it may possibly represent a link between the Old and New World species. It is obviously very close to *A. eucosmus,* but there are difficulties in interpreting the relationship. In the first place perfectly typical *A. eucosmus* is sympatric in the Alaska Range with *A. Sealei* (cf. *Cody & Webster 5541,* US) and technically indistinguishable forms occur with *A. Sealei* on the arctic slope (cf. *Spetzman 2120,* US, and *Scholander 395,* US, the last with small pod, but racemes up to 8 cm. long). Then, although both the flower and the fruit of *A. Sealei* are on the average a little smaller than those of Cordilleran *A. eucosmus,* they are identical in form. Possibly *A. Sealei* represents an earlier stage in the evolutionary differentiation of a small-flowered American type from either the ancestral *A. norvegicus* or the precursor of both. It may have survived Pleistocene glaciation in an Alaskan refugium, whereas typical *A. eucosmus* may have immigrated into southeast Alaska since retreat of the last ice sheet. For the present it is scarcely possible to distinguish *A. Sealei* taxonomically, for all the possible known differential characters occur separately or even in pairs in populations of unquestionably typical *A. eucosmus.* The status of *A. Sealei* cannot be settled until the Alaskan plant has been compared with an adequate sample of *A. norvegicus* as this occurs in east Asia. It is possible that *A. eucosmus* is only a small-flowered Nearctic aspect of a circumpolar and temperate-alpine *A. norvegicus.*

7. Astragalus Robbinsii

Variable in stature but usually slender, very thinly to quite densely strigulose, strigulose- or pilose-villosulous with straight and appressed, incumbent, or more rarely spreading hairs up to 0.2–0.8 mm. long, the herbage usually green, the leaflets of membranous texture, when large visibly penninerved, bicolored, pallid and usually pubescent beneath, darker green and glabrous or glabrescent above, the

upper surface (when dried) often appearing minutely whitish-tuberculate, the inflorescence commonly but not consistently black-pubescent; *stems* usually several, erect, incurved-ascending, or (in exposed sites) diffuse or even trailing, arising together from the root-crown or shortly forking caudex, simple, (0.7) 1–4.5 (6) dm. long, at base leafless and commonly purplish, the lowest internodes short or inhibited, the upper 5–9 developed; *stipules* 2–8 mm. long, dimorphic, the lowest (approximate or loosely imbricated) early becoming papery and brownish, several-nerved, strongly adnate to the suppressed petiole, broadly ovate, obtuse, fully amplexicaul and commonly broader than the stem, either free or united through half their length, the upper ones progressively narrower, ovate or lanceolate, more rarely oblong or triangular-acuminate, thinly herbaceous or submembranous, often purplish, semi- or fully amplexicaul, free, the blades often deflexed, glabrous or glabrate dorsally, thinly ciliate; *leaves* 3–10 (12) cm. long, the lowest often slender-petioled, the rest (sometimes all) subsessile, with (5) 7–17 lance-oblong, oblong-elliptic, ovate-oblong, ovate, or obovate, obtuse or emarginate, exceptionally subacute, flat leaflets (3) 5–32 mm. long; *peduncles* incurved-ascending or erect from ± 2–3 distal axils, (3.5) 4–21 cm. long, nearly always surpassing the leaf; racemes (3) 6–21 (25) -flowered, often moderately compact at early anthesis, nearly always moderately or greatly elongating, sometimes loose from the first, the flowers early spreading and ultimately declined, the fruits loosely secund, the axis (1) 1.5–18 cm. long in fruit; *bracts* submembranous, pallid or purplish, narrowly ovate to linear-oblong or -lanceolate, (1) 1.5–5.5 mm. long; *pedicels* slender, at anthesis ascending or arcuately spreading, 0.9–2.5 mm. long, in fruit recurved, geniculate at base and horizontally spreading, abruptly dejected, or (from decumbent peduncles) apparently ascending, a trifle thickened, 1.5–5 mm. long; *bracteoles* usually 0, minute when present, sometimes attached well below the calyx; *calyx* (3.4) 3.7–8 mm. long, thinly strigulose to densely strigose-villosulous with black or fuscous, commonly mixed with a few pale, more rarely with nearly all or all white hairs, the subsymmetric disc 0.7–1.1 (1.5) mm. deep, the campanulate, pallid or more often purple- or red-tinged tube (2.4) 2.6–4.5 mm. long, 1.8–3 (3.4) mm. in diameter, the subulate, more rarely linear- or triangular-subulate dorsal and lateral teeth 0.8–3.4 mm. long, the ventral pair often broader and shorter, the whole becoming papery, marcescent unruptured; *petals* pale purple with whitish claws, pale slate-blue, or more rarely whitish, but the keel-tip then usually pink- or purple-maculate; *banner* gently recurved through ± 40° broadly oblanceolate to obovate-cuneate, shallowly or deeply notched, 7.2–11.5 mm. long, 3.8–7 mm. wide; *wings* 6.1–9.3 mm. long, the claws 2.8–4.2 mm., the narrowly oblong or oblong-oblanceolate, nearly straight, obtuse, truncate, or shallowly (deeply) emarginate blades (4) 4.3–7 mm. long, 1.4–2.2 mm. wide; *keel* 5.4–7.9 mm. long, the claws 2.7–4.2 mm., the half-obovate blades 3.1–4.8 mm. long, 1.7–2.5 mm. wide, abruptly incurved through 90–105 (110)° to the bluntly rounded (exceptionally subporrect and then deltoid) apex; *anthers* 0.3–0.5 mm. long; *pod* essentially pendulous (sometimes spreading from horizontal peduncles), stipitate, the slender stipe usually 1.5–5.5 mm. (in western United States sometimes only 0.5–1.5 mm.) long, the subsymmetrically ellipsoid, half-ellipsoid, oblong- or rarely lance-ellopsoid, straight or very slightly decurved body 8–25 mm. long, (3) 3.5–5.5 (6) mm. in diameter, cuneately or acuminately tapering into the stipe, contracted distally into a conic-subulate or subulate, cusplike beak 0.5–3 mm. long, obscurely triquetrous, with the three faces almost equally broad or the low-convex to depressed dorsal face commonly a little narrower than the lateral ones, the ventral angle carinate by the filiform, convexly arched suture, the thin, green or purplish valves becoming papery-membranous and delicately cross-reticulate, mi-

nutely strigulose to densely pilosulous with black or fuscous, commonly mixed with a few (many, rarely all) white hairs up to 0.2–0.5 mm. long, inflexed as a hyaline septum 0.2–1.6 (2) mm. wide; *ovules* 7–11, rarely 3–6; *seeds* brown, sometimes purple-speckled, smooth and somewhat lustrous, 1.4–2.3 mm. long.

The Robbins milk-vetch is a collective species, with two centers of dispersal, one Cordilleran from Colorado to eastern Alaska, the other extending from New England into eastern Canada. The dispersal of the species is like that of many boreal-montane phanerogams which bore the brunt of the Tertiary glaciations. In each of the main areas it is represented by three virtually monomorphic and probably genetically fixed varieties confined to a narrow ecological niche, but there is one relatively widespread and variable entity common to both areas, and it is this var. *minor* which forms the nucleus of the species. The Robbins milk-vetch has been known for well over a century, but the racial situation was only investigated comparatively recently, a beginning being made (if we discount the discovery of var. *occidentalis*) in the nineties by W. W. Eggleston in New England. Between the years 1923 and 1933 the results of studies undertaken by three botanists of widely divergent philosophy appeared in print, and it is interesting to compare them. The account of Jones (1923, p. 133–5), whose inclusive concept of *A. Robbinsii* is adopted in these pages, is the least critical in detail. Jones mistakenly took up for the species the epithet *labradoricus* properly belonging (although a misnomer) to *A. alpinus* var. *Brunetianus,* and established three varieties: a typical one (= our vars. *Jesupi, Fernaldi* and the New England aspect of var. *minor*); a var. *Robbinsii* (= our var. *Robbinsii* with an admixture of var. *minor* and the latter's range in the East); and a var. *occidentalis* (= our var. *minor* in its western aspects, var. *occidentalis* sens. str., and var. *alpiniformis*). Rydberg (1928, pp. 124–9) described nine species of *Atelophragma* covering the same range of variation, four of them new, and divided them between two sections, *Robbinsiana* and *Oroboidea,* distinguished simply by the length of the stipe, an example of how far one can be led astray by over emphasis of a single character. Finally Rousseau (1933, passim, in relation to *A. alpinus* and *A. Fernaldi* in Quebec) published notes on the eastern as well as the Rocky Mountain components of the complex, accepting them in *Astragalus* at Rydberg's specific level. I must reluctantly remark that the drawings of floral parts and fruits in Rousseau's figure (op. cit. fig. 8) are at best no more than idealized average examples; and since no attempt is made to illustrate variation, an altogether false picture of the so-called species is drawn. Rousseau's table of relationships (op. cit. fig. 9), which outlines a phylogenetic scheme for our sects. *Cenantrum, Astragalus, Oroboidei,* and *Hemiphragmium,* is open to criticism not only on theoretical grounds, but also because it presents a narrow provincial view of a problem involving four or five times as many species in Asia and several groups not even represented in America. The Alaskan relatives of *A. Robbinsii* have been elaborated more recently by Hultén (1944). In the present account the species is considered to consist of seven varieties, one of them extinct.

In all the herbaria that I have consulted I have found *A. Robbinsii* confused with *A. alpinus.* The two species are much alike in coloring of the leaves and flowers, in the often dark-hairy inflorescences and fruits, and in their preference for streamsides and moist places, where they are often found together. The following contrasts should serve to forestall confusion in the future:

1. Petals regularly graduated, the keel shorter and little or no wider than the wings, much shorter than the banner; *stems* arising together from the root-crown at soil-level; *leaflets* 7–17; *pod* obscurely and bluntly trigonous, depressed or flattened but not or scarcely sulcate dorsally ..... *A. Robbinsii*

1. Petals (in the range of *A. Robbinsii*) irregularly graduated, the prominent keel longer or as long as and also wider than the wings, equaling or little shorter than the banner; *stems* arising singly or few together from buds on slender, subterranean caudex-branches; *leaflets* mostly 15–25; *pod* more sharply trigonous, strongly grooved dorsally ..... *A. alpinus*

The species is also sometimes confused with forms of *A. aboriginum,* which has much the same wide and interrupted range; the latter is easily distinguished by its apically cleft and not obtuse or merely emarginate wing-petals and also by its usually more strongly compressed, decidedly two-sided pod.

Key to the Varieties of A. Robbinsii

1. Leaves densely gray-villous-pilosulous beneath, the longest hairs up to 0.6–0.8 mm. long; *stipe* of the pod 1.2–2 mm. long; *septum* within the pod 1.2–2 mm. wide; s. coastal Alaska ..... 7g. var. *Harringtonii*

1. Leaves thinly strigulose or pilosulous beneath, the hairs up to 0.2–0.6 (0.7) mm. long; *stipe* variable in length, but much longer in s. coastal Alaska; *septum* mostly less than 1 mm., rarely up to 1.5 mm. wide (2)
   2. Stipe of the pod 3–6.5 mm. long; plants of New England and Nova Scotia and of the n. Rocky Mountains and Alaska (3)
      3. Body of the pod (10) 13–25 mm. long, either densely pubescent with black (white) hairs or contracted distally into a cusplike beak 1.5–3 mm. long; *petals* pale purple or whitish with purple keel-tip (4)
         4. Beak of the pod short, 0.8–1.5 mm. long, the body densely strigose-pilosulous; lower surface of the *leaflets* uniformly pubescent (at least in New England); Rocky Mountains and Alaska, also montane in Vermont and New Hampshire, coastal in Nova Scotia ..... 7a. var. *minor*
         4. Beak of the pod conspicuous, 1.5–3 mm. long, the body thinly strigulose; *leaflets* glabrous beneath except for a few hairs on the midrib and margins; local along the Connecticut River in Vermont and New Hampshire ..... 7e. var. *Jesupi*
      3. Body of the pod 10–15 mm. long, minutely and sparsely black-strigulose, very shortly beaked, the beak not over 1 mm. long; *petals* whitish, the keel not maculate; formerly in the gorge of Winooski River near Burlington, Vermont (extinct since 1894) ..... 7d. var. *Robbinsii*
   2. Stipe of the pod short (sometimes obscure), 0.5–3 mm. long; mostly Cordilleran, but one var. in coastal Labrador, adjoining Newfoundland and e. Quebec (5)
      5. Ovules (6) 7–10; widespread, but not in Oregon (6)
         6. Racemes little elongating, the axis 1.2–6 (8) cm. long in fruit; *leaflets* pubescent above over the whole surface or at least marginally; s. Labrador and adjoining Newfoundland and Quebec ..... 7f. var. *Fernaldi*
         6. Racemes (or at least the lowest and most vigorous ones) quickly elongating, the axis 3–18 cm. long in fruit; *leaflets* glabrous above; western (7)
            7. Stipe of the pod usually over 1.5 mm. (rarely 1 mm.) long, the body (10) 13–25 mm. long; *racemes* mostly (6) 10–25-flowered, the axis 3–18 cm. long in fruit, but the pods even though distant from each other not greatly remote; lowest *stipules* fully amplexicaul but not or only obscurely connate; widespread from Colorado n.-ward, but not in n.-e. Nevada ..... 7a. var. *minor*
            7. Stipe of the pod 0.5–1.4 mm. long, the body 10–15 mm. long; *racemes* remotely (3) 6–12-flowered, the axis 6–15 mm. long in fruit; lowest *stipules* truly connate through ± half their length; local in the Ruby and East Humboldt Mountains, n.-e. Nevada ..... 7b. var. *occidentalis*
      5. Ovules 3–6; body of the *pod* short, 8–13 mm. long; local in the Wallowa Mountains, n.-e. Oregon ..... 7c. var. *alpiniformis*

7a. Astragalus Robbinsii var. minor

Variable in stature, the stems (1) 1.5–4 (6) dm. long, usually ascending, diffuse or trailing in exposed sites, sometimes hanging out from cliff-ledges; *leaves* 3–12 cm. long, with (7) 9–13 (15) leaflets (5) 7–25 (32) mm. long, strigulose beneath with subappressed or narrowly ascending-incumbent hairs up to 0.2–0.6 mm. long, exceptionally glabrate throughout; *peduncles* (3.5) 4.5–16 (19) cm. long; *racemes* (5) 7–20 (25)-flowered, the axis (2) 3–18 cm. long in fruit; *calyx* 4–6.8 (7.3) mm. long, the tube (3) 3.2–4.5 mm., the teeth 0.7–2.3 (2.6) mm. (in Glacier Bay, Alaska, up to 3.3 mm.) long; *petals* pale purple or whitish with purple keel-tip; *banner* 7.2–11.5 mm., keel 5.8–7.7 mm. long; *stipe* of the pod (1) 1.5–5 (6.5) mm. long, the ellipsoid body (1) 1.3–2.5 cm. long, 3.5–5.5 mm. in diameter, obtusely trigonous, flattened dorsally, the beak 0.5–1.6 mm. long, the valves loosely strigulose-pilosulous with black or black and white hairs up to 0.2–0.4 mm. long, exceptionally glabrescent, the septum 0.2–1 (1.5) mm. wide; *ovules* (6) 7–10.—Collections: 112 (iii); representative: *Funston 67* (US); *J. M. Macoun 63,753, 70,441* (NY); *J. W. & E. M. Thompson 328* (CAS, NY), *543* (NY, WTU); *J. W. Thompson 10,939* (NY, WTU), *13,609* (CAS, NY, WS, WTU), *14,072* (CAS, NY, RSA, WTU); *Hitchcock & Muhlick 11,571* (CAS,

NY, RSA, WS); *Ripley & Barneby 10,051* (CAS, RSA, UTC), *10,437* (CAS, NY, RSA); *Eggleston & Grout* (from Smuggler's Notch, Vermont) *in June, 1894* (NY, PH); *Eggleston* (ibid.) *July 1, 1894* (NY), *May 31, 1896* (MINN, wrongly labeled "type" of *A. Blakei* by Sheldon), *July 5, 1897* (NEBC, wrongly labeled "type"), *1949, 1950* (NY); *W. B. Schofield 4800* (NY, RSA).

Stream banks, mountain meadows, damp thickets, moraines, often with willows and shrubby cinquefoil, in sun or shade, in moist or cool humus, or alluvial soil overlying granites or limestones, widespread and common but of interrupted range in the southern and central Rocky Mountains from ± latitude 53° N. in Alberta and British Columbia south to northwestern Wyoming, and again in the high mountains of central and southwestern Colorado, west to the Marble Mountains in British Columbia, the Okanogan Plateau in eastern Washington, and the high mountains of central Idaho, in this area mostly in the timber belt at ±4000–10,500 feet, in Colorado (and in northern Montana) ascending to dry but cold, rocky tundra and up to 11,900 (possibly "12,500") feet, in Alberta extending rarely along streams out into the prairie zone; also disjunctly in the Yukon Valley, east-central Alaska, and at or near sea level (in a form approaching var. *Harringtonii*) on the shores of Glacier Bay, coastal southern Alaska; also remote from the Cordilleran range on moist talus and ledges of shaded or north-facing cliffs, very local in the mountains of northern and central Vermont (Mt. Mansfield; Willoughby Mt. and vicinity; Pond Mt. Wells, Rutland County) and on the St. John River in extreme northern Maine; again isolated on sea bluffs of Cape d'Or, Cumberland County, Nova Scotia.—Map No. 5.—June to August.

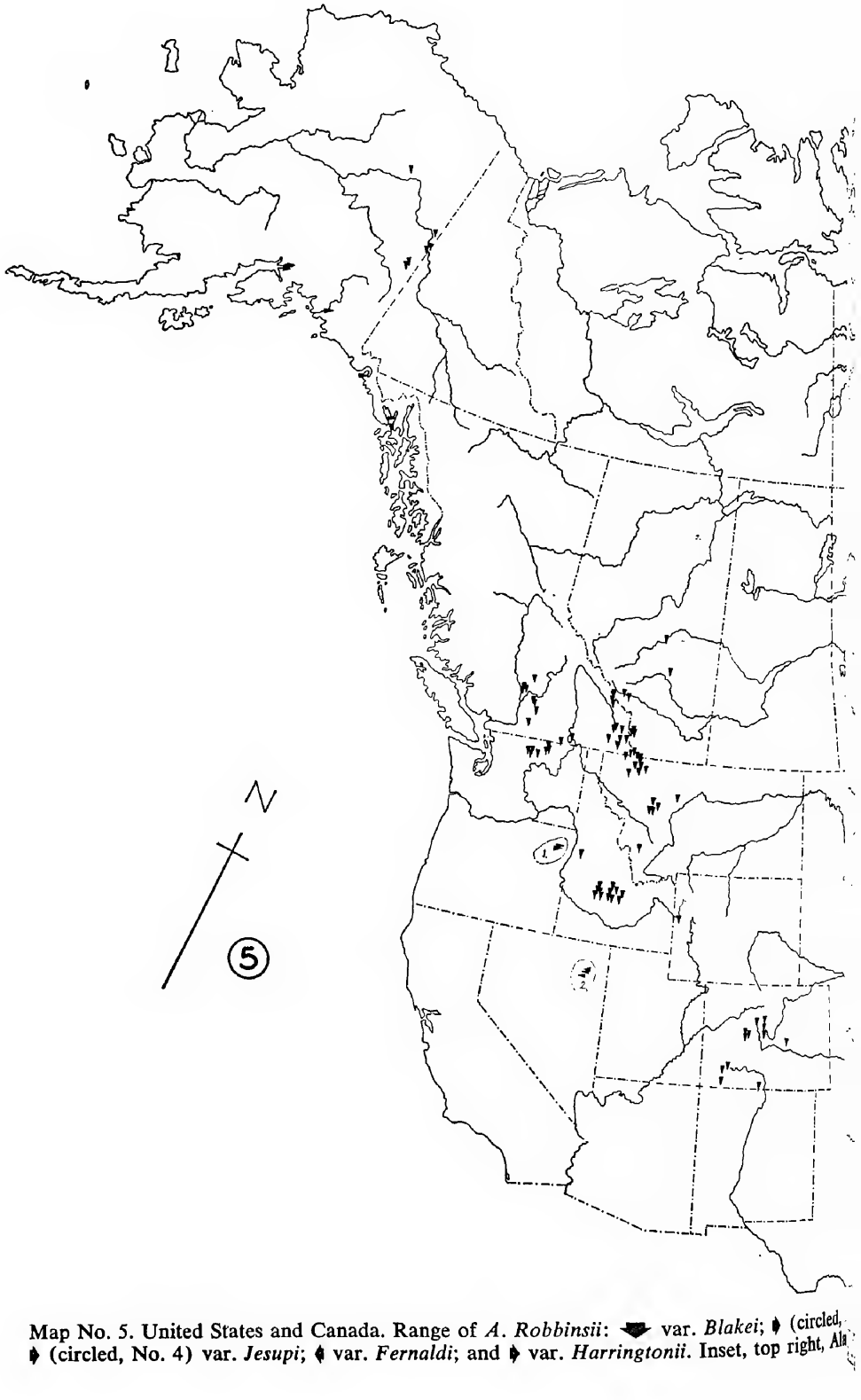
ASTRAGALUS ROBBINSII var. MINOR (Hook.), comb. nov., based on *Phaca elegans* β *minor* Hook., Fl. Bor.-Amer. 1: 144. 1831.—"... on the higher summits of the mountains. *Drummond.*"—Holotypus, collected in 1825–7, mounted on the same sheet with the holotypus of *Phaca elegans,* but distinguished by the legend "β, Hook.," K!—*A. minor* (Hook.) Jones, Contrib. West. Bot. 10: 64. 1902, nom. provis. *A. eucosmus* fma. *minor* (Hook.) Rouss. in Contrib. Lab. Bot. Univ. Montréal 24: 43. 1933, quoad nom.

Astragalus Blakei (Rev. Joseph Blake, 1814–1888)) Egglest. in Bot. Gaz. 20: 271. 1895. —"Type stations: Willoughby Mt., Smuggler's and Nebraska Notches, Vt., Willoughby Mt., Westmore, Vt. Rev. Joseph Blake (previous to 1856), etc. Smuggler's Notch, Mt. Mansfield, Stowe, Vt., C. G. Pringle, etc. Nebraska Notch, Mt. Mansfield, Underhill, Vt., C. G. Pringle and F. H. Horsford ..."—Spm. authent., *Blake* (from Willoughby Mt.) in June, 1861 (NY, PH), and June, 1864 (PH)! Eggleston's collections of 1894 cited above were distributed under the nomen nudum of *A. Robbinsii* var. *borealis* (one sheet at NY named *A. Blakei*) and are doubtless paratypi.—*A. Robbinsii* var. *borealis* (northern) Egglest., l.c., in syn. *Atelophragma Blakei* (Egglest.) Rydb. in Bull. Torr. Club 55: 125. 1928. *Astragalus Robbinsii* var. *Blakei* (Egglest.) Barneby ex Gleas., New Ill. Fl. 2: 419. 1952.

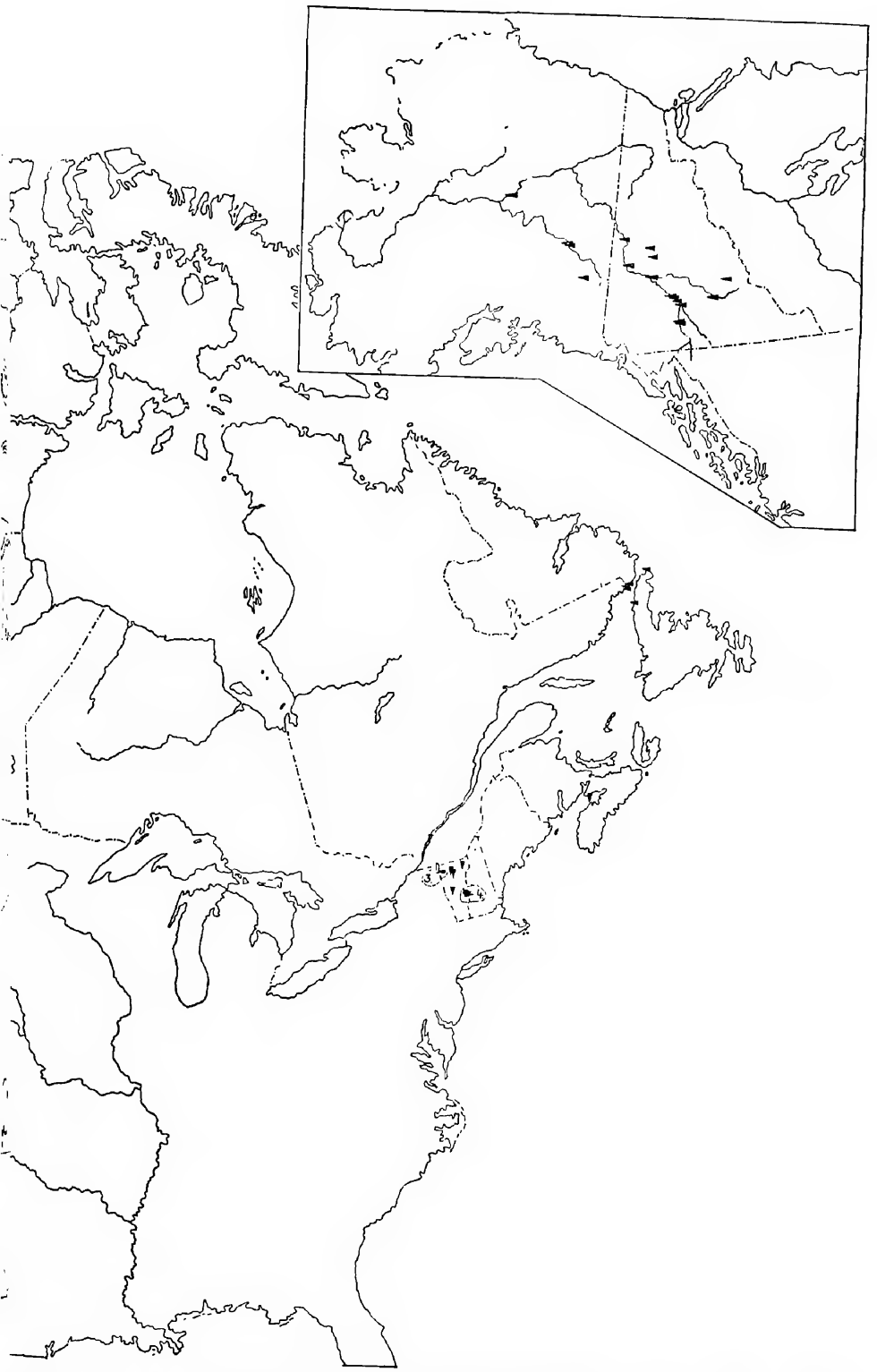
Astragalus Macounii (John Macoun, 1832–1920, pioneer Canadian botanist) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 243. 1900.—"BRITISH COLUMBIA: Deer Park, Lower Arrow Lake, [June 5] 1890, *John Macoun 25* ..."—Holotypus, NY! isotypus, US!—*Atelophragma Macounii* (Rydb.) Rydb. in Bull. Torr. Club 32: 660. 1905. *Astragalus labradoricus* var. *occidentalis* sensu Jones, Rev. Astrag. 134, pro max. parte, exclus. basonym. 1923.

Atelophragma Collieri (the collector) Rydb. in Bull. Torr. Club 55: 128. 1928.—"Type collected at Eagle, Alaska, June 29, 1902. *A. C. Collier 50* ..."—Holotypus, US!—*Astragalus Collieri* (Rydb.) Porsild in Sargentia 4: 50. 1943.

From the points of view of individual numbers and extensive (though interrupted) dispersal, the var. *minor* is by far the most important form of the Robbins milk-vetch. There seems little doubt that it represents the archetype of the species and that the remaining varieties are not much more than minor variants which have been able to maintain a certain individuality through accidents of physical isolation from the main gene-stream. In the Rocky Mountains var. *minor* (often passing under the names *A. Macounii* or *A. occidentalis*) is variable in several directions, notably in stature, pubescence, and length of the pod's stipe and body. It is ordinarily an erect plant of streamsides and moist thickets in the timber belt, but it climbs occasionally to open crests in the tundra zone, there becoming dwarf and diffuse (cf. *Weber & Barclay 9188,* COLO, from central Colorado; *Calder & Kukkonen 27,204,* NY,



Map No. 5. United States and Canada. Range of *A. Robbinsii*: ▬ var. *Blakei*; ◗ (circled, ◗ (circled, No. 4) var. *Jesupi*; ◖ var. *Fernaldi*; and ◗ var. *Harringtonii*. Inset, top right, Ala



r. *alpiniformis*; ⧫ (circled, No. 2) var. *occidentalis*; ⧫ (circled, No. 3) var. *Robbinsii*; ukon. Range of *A. Williamsii*.

from southeastern British Columbia; *Breitung 16,435,* NY, from southern Alberta). Commonly the leaves are so thinly pubescent that they appear glabrous to the casual glance, but the lower surface is sometimes cincereous when young and forms with genuinely glabrate foliage do occur (cf. *Hitchcock & Muhlick 14,104,* NY). The inflorescence and pod are, as a rule, black- or fuscous-hairy, but the vesture is sometimes largely or even entirely white. The variants mentioned so far are quite minor and of sporadic occurrence, and no correlation seems to exist between the length of the pod-body and a significant pattern of dispersal. It is otherwise with the length of the stipe which, usually quite short in Colorado, tends to become (in a series only rarely interrupted or irregular) longer as one traces var. *minor* northward along the Cordillera, reaching a length of 3.5–4.5 mm. or exceptionally 5–6.5 mm. (cf. *Standley 15,692a,* from Glacier Park, US) in Alberta and northwest Montana. Some individual plants from this area (cf. *Macoun,* from Kicking Horse Lake, *in 1885,* NY, significantly identified by Sheldon as *"A. Jesupi"*) are technically inseparable from the plant of the New England mountains upon which var. *Blakei* is based. For many years I have tried to maintain a separate category for the Cordilleran *A. Macounii* (and have freely used an unpublished trinomial in annotations), but this course no longer seems logically defensible. At the time Eggleston was studying the eastern forms of the Robbins milk-vetch, he must have suspected that *A. Blakei* was conspecific with at least some of its western relatives, for he applied his manuscript var. *borealis,* as well as the binomial *A. Blakei,* in the herbarium to a few plants of both areas. The Cordilleran populations possess collectively a greater fund of variation than would be possible in the four or five restricted stations in New England and Nova Scotia. The eastern plants in the interior have relatively large flowers and relatively dense pubescence on the pods, but since these features can be matched in fine detail by individual Cordilleran plants, no taxonomic division is possible. The population on Cape d'Or in Nova Scotia matches some Rocky Mountain material very closely.

The var. *minor* is apparently unknown in the Rocky Mountains northward from about the latitude of Banff, but it reappears in the Yukon Valley just west of the Yukon-Alaska line. The Alaskan plant from this area was described by Rydberg as *Atelophragma Collieri,* supposed to differ from *A. Macounii* (our Cordilleran var. *minor*) in its larger flower and from the coastal Alaskan *A. Harringtonii* in its longer stipe and thin pubescence. I agree with Hultén (1943, p. 1088) that the plant of interior Alaska is essentially identical with *A. Macounii.* In the original description of *A. Collieri* Rydberg cited a peculiar plant, *Anderson 1264* (NY) from Glacier Bay, that is from the Alaskan coast where var. *Harringtonii* is the common phase of *A. Robbinsii.* Evidently representing the same type are three other collections from the Bay, *Coville & Funston 744* from Port Gustavus (US), *W. S. Cooper 175* (US) and *Anderson 1261* from Willoughby Island (US). These plants have been referred to var. *minor* with misgiving, for they are unusual in their long calyx-teeth (up to 2.9–3.3 mm. long), long stipes (4–5 mm.) and broad septum (1–1.5 mm. wide). The calyx-teeth and septum are suggestive of var. *Harringtonii,* which also occurs in typical form on Glacier Bay, but the pubescence is that of var. *minor.* Hultén (op. cit., p. 1087) listed *Anderson 1261* as *A. Harringtonii,* but it does not fit comfortably into my concept of that entity. Possibly more material will show that another very local variety like those described below is isolated at this point on the coast. It should be noted that Hultén's record (op. cit., p. 1088) of *A. Macounii* from the Behring Strait district in far western Alaska is based on a specimen (*Palmer 658,* NY) of *A. alpinus.*

7b. Astragalus Robbinsii var. occidentalis

Very slender, weak and diffuse, the stems (1) 1.5–4.5 dm. long; *leaves* 4–9.5 cm. long, with (5) 7–11 ample leaflets (5) 8–30 mm. long, strigulose beneath with subappressed hairs up to 0.25–0.5 mm. long; *peduncles* (6) 8–21 mm. long; *racemes* remotely (3) 6–12-flowered, the axis (2) 6–15 cm. long in fruit; *calyx* 3.6–4.6 mm., the tube 2.6–3 mm., the teeth 1–1.6 mm. long; *petals* lilac; *banner* ± 7.4 mm., keel ± 5.4 mm. long; *stipe* of the pod 0.5–1.4 mm. long, the body (0.8) 1–1.5 cm. long, (3) 4–5 mm. in diameter, flattened or obscurely depressed dorsally, the beak 0.8–1.2 mm. long, the valves strigulose with appressed or narrowly ascending hairs up to 0.2–0.35 mm. long, the septum 0.8–1.2 mm. wide; *ovules* 8.—Collections. 12 (o); representative: *Jones* (from East Humboldt Mountains) *in 1897, 1901* (NY, POM); *Munz 16,198* (CAS, POM); *Train 4599* (NA, NY); *Holmgren 1859* (NY, UTC, WS).

Banks of streams and moist soil of timbered creek beds, ± 8000–10,000

feet, very local, known only from the Ruby and East Humboldt Mountains, Elko County, Nevada.—Map No. 5.—July and August.

ASTRAGALUS ROBBINSII var. OCCIDENTALIS (western) Wats., Bot. King 70. 1871.—"East Humboldt Mountains, Nevada; 10,000 feet altitude; . . . 268."—Holotypus, *Watson 268,* collected in August, 1868, US! isotypi, GH, NY!—*Astragalus occidentalis* (Wats.) Jones, Contrib. West. Bot. 8: 17. 1898. *A. labradoricus* var. *occidentalis* (Wats.) Jones, Rev. Astrag. 134, quoad nom. 1923. *Atelophragma occidentale* (Wats.) Rydb. in Bull. Torr. Club 55: 128. 1928.

The var. *occidentalis* is apparently not distinguished from var. *minor* by any one consistent character, but is nevertheless easily recognized in practice. The very slender growth-habit, few but ample leaflets, remotely few-flowered racemes, and usually small, shortly stipitate or subsessile pod all contribute to its individuality of aspect. Some collections of var. *minor* from the Sawtooth Mountains in Idaho approach var. *occidentalis* in many of the features mentioned, but this is hardly surprising in view of the close floristic relationship between the East Humboldt Mountains and the mountains of central Idaho.

All known specimens of var. *occidentalis* that are accompanied by exact data of locality originated in the Ruby Mountains, most of them along Lamoille Canyon, one of them at Island Lake. Possibly those labeled "East Humboldt Mountains," a term sometimes extended to cover the Ruby Range, came from the same small area. Narrow endemism, as shown by var. *alpiniformis* and var. *Jesupi,* is characteristic of the Robbins milk-vetch.

7c. ASTRAGALUS ROBBINSII var. ALPINIFORMIS

Closely resembling the more slender, diffuse forms of var. *Blakei,* except as follows: *leaflets* 9–17, ovate to obovate or lance-elliptic, mostly emarginate, (3) 5–12 mm. long; *stipe* of the pod 1.2–2 mm. long, the rather broadly ellipsoid body 8–13 mm. long, 3.7–5 mm. in diameter, the apical cusp 0.7–2.2 mm. long, the valves strigulose with black, largely black, rarely all white hairs 0.1–0.35 mm. long; *ovules* 3–6.—Collections: 5 (o); representative: *Maguire & Holmgren 26,688* (GH, NY, RSA, UTC, WS), *27,037* (NY, RSA, UTC); *Peck 22,499* (WILLU).

Brushy or shingly stream banks and gravel bars, sometimes inundated by spring freshets, on granite, from 4200 upward to ±7000 feet along Hurricane Creek, Wallowa Mountains, Oregon.—Map No. 5.—June to August.

ASTRAGALUS ROBBINSII var. ALPINIFORMIS (Rydb.) Barneby ap. Hitchc. & al. in Univ. Wash. Pub. Biol. 17: 258. 1961, based on *Atelophragma alpiniforme* (resembling *A. alpinus*) Rydb. in Bull. Torr. Club 55: 129. 1928.—"On bars of Hurricane Creek, Wallowa Mountains, Oregon, August 25, 1898, *Cusick 2103.*"—Holotypus, GH! isotypi, G, K, MINN, MO, ND, ORE, P, US, WS!—*A. alpinus* var. *alpiniformis* (Rydb.) Peck, Man. Pl. Ore. 447. 1940.

The var. *alpiniformis* resembles var. *occidentalis* in its short, shortly stipitate pod, differing in its more numerous and relatively small leaflets. The few ovules constitute its best differential character. The variety is probably not directly related to or derived from var. *occidentalis* but may have arisen as a parallel mutation from var. *minor* and is only assured an independent existence through its isolation in the Wallowa Mountains. The collections of var. *minor* from stations nearest to Hurricane Creek in Idaho show no sign of passage toward var. *alpiniformis.*

In its riparian habitat, apparently quite similar to that of var. *Jesupi* along the Connecticut River in New England, var. *alpiniformis* is subjected to flooding during the spring thaw, and the plants are sometimes partly buried under mobile shingle. The subterranean root-crown in such plants might suggest *A. alpinus,* but the resemblance is purely fortuitous.

7d. ASTRAGALUS ROBBINSII var. ROBBINSII

Stems slender, ascending, (11) 15–27 cm. long; *leaves* 3.5–8.5 cm. long, with 7–13 leaflets 6–18 mm. long, minutely strigulose beneath with scattered hairs up to 0.25–0.4 mm. long; *peduncles* (5) 7–15 cm. long; *racemes* (6) 10–21-flowered, the axis (1) 3–10 cm. long in fruit; *calyx* 4–5 mm. long, the tube 3–3.5 mm., the teeth 0.8–1.8 mm. long; *petals* whitish, immaculate; *banner* 8–8.5 mm. keel 6–6.7 mm. long; *stipe* of the pod (2) 3–3.5 mm. long, the body 1–1.5 cm. long, (3.5) 4–5 mm. in diameter, compressed-triquetrous, flattened dorsally, the beak

not over 1 mm. long, the valves minutely and sparsely black strigulose with hairs 0.2–0.4 mm. long, the septum ± 0.3 mm. wide; *ovules* 7–8.—Collections: 11 (o); representative: *Pringle* (from Burlington, Vermont) *in May and June, 1877* (NY), *in May and June 1878* (ND, NY, OB, WIS); *Oakes* (ibid.) *without date* (GH, NY, WIS).

Limestone ledges near and above high water, associated with *Potentilla fruticosa,* along the lower Winooski (Onion) River near Burlington, Vermont, the one known station obliterated by a dam erected in 1894.—Map No. 5.—May to early June.

ASTRAGALUS ROBBINSII (Oakes) Gray, Man. Bot., Ed. 2, 98. 1856, based *Phaca Robbinsii* (James Watson Robbins, M. D., 1801–1879) Oakes in Hovey's Mag. Hort. 7: 181. 1841.—"On rocky ledges, overflowed in the spring, on the banks of the Onion river, Burlington, Vermont. Dr. Robbins, 1829."—Spma. authent., *Oakes in May, 1840,* GH! and labeled "Burlington, Vt., *Robbins,* August, 1829" ex herb. Oakes., NY! The spm. from Burlington (without further data) at PH, ex herb. Short., is probably an isotypus.—*Tragacantha Robbinsii* (Oakes) O. Kze., Rev. Gen. 947. 1891. *Astragalus labradoricus* var. *Robbinsii* (Oakes) Jones, Rev. Astrag. 133. 1923. *Atelophragma Robbinsii* (Oakes) Rydb. in Bull. Torr. Club 55: 124. 1928.

The typical form of the Robbins milk-vetch, known from only one population extinct for almost seventy years, differs (or differed) from other New England and long-stipitate Cordilleran varieties in its small, pallid flowers and relatively short, minutely and sparsely pubescent pod. If the circumstances of its discovery and naming had not focused a particular attention upon it, and it had been discovered only recently in the Rocky Mountains, it would probably have been passed over as one more minor variant of what is here called var. *minor* (including the eastern *A. Blakei*). As one looks eastward today from the dam that links the cities of Burlington and Colchester and backs up the waters of the Winooski River over the limestone ravine, which formerly provided a cool retreat in the lowlands for a plant of boreal-montane affinities, the prospect is dominated by the profile of Mount Mansfield, the type-locality of *A. Blakei,* only a few miles distant. It seems most probable that var. *Robbinsii* had its origin through seeds brought down from the hill country to the east, and that it was able to persist in this one favored station because of a chance mutation adapted to a lowland calcareous habitat.

The Robbins milk-vetch was formerly thought to be widely dispersed in New England, but all records have been traced back to other varieties, of which the critical characters were only appreciated in modern times. The history of *Phaca Robbinsii* was recounted in detail by Rydberg (in Torreya 24: 98, sequ. 1924), the first to circumscribe the entity in its present narrow sense. After its discovery in 1829, *A. Robbinsii* was collected in 1841 by J. Carey, in 1846 by Oakes, and several times between 1877 and 1891 by C. G. Pringle, A. J. Grout, and Rev. James Blake. It was apparently last seen in the living state by W. W. Eggleston on June 15 and 18, 1893. The plant recently reported as *A. Robbinsii* from coastal Nova Scotia (Schofield in Rhodora 57: 308. 1955) represents an outlying population of var. *minor.*

7e. ASTRAGALUS ROBBINSII var. JESUPI

Similar in habit to var. *Blakei,* the stems 1–3 dm. long; *leaves* (3) 3.5–8.5 cm. long, with 9–15 (17) leaflets (6) 8–20 (25) mm. long, glabrous except for a few scattered hairs up to 0.35–0.55 mm. long on the margins and midrib beneath; *peduncles* (5) 7–16 cm. long; *racemes* 8–21-flowered, the fruiting axis (2.5) 4–13.5 cm. long; *calyx* 4.1–6 mm. long, the tube 3.2–4 mm., the teeth 0.9–2.5 mm. long; *petals* pale purple, the banner more deeply purple-veined; *banner* 9.7–11 mm., keel 6.9–7.6 mm. long; *stipe* of the pod 3.5–4.5 (5) mm. long, the inversely lunate-ellipsoid body 1.4–2.1 mm. long, 3–5.5 (6) mm. in diameter, the prominent, erect or declined cusp 1.5–3 mm. long, the valves strigulose with black hairs 0.1–0.3 mm. long; *ovules* 9–11.—Collections: 11 (i); representative: *Eggleston 176* (NY, OB), *in May and June, 1894* (NY, OB); *Barneby 10,155* (CAS, RSA).

Moist crevices of shelving rocks, just above high water, sometimes in the shade of overhanging shrubs, very local along both banks of the Connecticut River

for a few miles above and below Lebanon, in Sullivan County, New Hampshire, and Windsor County, Vermont.—Map No. 5.—May to July.

ASTRAGALUS ROBBINSII var. JESUPI (Prof. Henry Griswold Jesup, 1826–1903) Egglest. & Sheld. in Minn. Bot. Stud. 1: 155. 1894 (*"jesupi"*).—"... on old ledges above high water of the Connecticut River near Hartland, Vt., July, 1891, and on ledges near Sumner's Falls, near Plainfield, N. H.... The type specimens were collected by Mr. Eggleston ..."—Lectotypus, collected by *Eggleston* at Hartland, June 7, 1891, MINN!—Better specimens from the same place collected in May, 1894 (3–4 months after publication), distributed as "types" by Eggleston (NY) and one dated 1898 labeled as type by Sheldon (MINN) are authentic but not isotypi.—*Astragalus Jesupi* (Egglest. & Sheld.) Britt., Man. 1048. 1901. *Atelophragma Jesupi* (Egglest. & Sheld.) Rydb. in Bull. Torr. Club 55: 125. 1928.

The Jesup milk-vetch was collected first in 1877, by Prof. Jesup, at Sumner's Falls, where it is associated with *A. alpinus* var. *Brunetianus* on seeping ledges of crystalline rock which crops out here and there along the rapids of the Connecticut River. It was still locally plentiful there in 1950. A second population, discovered by Eggleston near Hartland in 1891, was still extant in 1919 (*Carpenter*, CAS). The variety is known to me from only these two stations. It is distinguished from the closely related var. *minor*, found on the mountains adjacent to the north, by its nearly glabrous foliage and especially by the elongate, erect, or gently declined cusp terminating the distinctly but very gently decurved pod.

7f. ASTRAGALUS ROBBINSII var. FERNALDI

Low, decumbent or weakly ascending, the stems 1.3–3 dm. long; *leaves* 3.5–8 cm. long, with 9–17 leaflets 7–22 mm. long, cinereous beneath with subappressed or narrowly ascending hairs up to 0.35–07 mm. long, at least thinly pubescent toward the margins above, sometimes the whole upper surface strigulose; *peduncles* 4–10.5 cm. long; *racemes* 7–20-flowered, not greatly elongating, the axis 1.2–6 (8) cm. long in fruit; *calyx* rather densely white- or black-strigulose, 4.5–6.5 mm. long, the tube 3.2–4 mm., the teeth 1.5–2.5 mm. long; *petals* purplish or grayish-lilac; *banner* ± 9–10 mm. long; *stipe* of the pod 1.2–3 mm. long, the body 1–1.8 cm. long, 4–5.5 mm. in diameter, abruptly contracted into a beak 1.5–2 mm. long, the valves densely and loosely strigulose-pilosulous with black or white hairs up to 0.25–0.55 mm. long, the septum 0.2–0.8 mm. wide; *ovules* 8–10.—Collections: 5 (o); representative: *Waghorne* (from Labrador) *in 1894* (NY); *Fernald & Long 28,593* (GH); *Wiegand, Gilbert & Hotchkiss 28,597* (GH, K, NY); *Penson* (from Cook's Harbor) *in 1941* (US).

Limestone or calcareous sandstone terraces and rocky or turfy bluffs near the coast, local, known only from the Straits of Belle Isle, northwestern Newfoundland, southern Labrador, and far eastern Quebec.—Map No. 5.—June to August.

ASTRAGALUS ROBBINSII var. FERNALDI (Rydb.), stat. nov., based on *Atelophragma Fernaldi* (Merritt Lyndon Fernald, 1873–1950) Rydb. in Bull. Torr. Club 55: 126. 1928.—"Blanc Sablon, Labrador, Aug. 6, 1910, *Fernald 3632*."—Holotypus, collected by Fernald with K. M. Wiegand, NY! isotypi, GH (2 sheets), US!—*Astragalus Fernaldi* (Rydb.) H. F. Lewis in Canad. Field Nat. 46: 36. 1932.

The Fernald milk-vetch was described by Rydberg as related to *A. Macounii* (= our var. *minor*), supposedly differing in its white-hairy calyx and pod, longer calyx-teeth, and leaflets pubescent above as well as beneath. The relationship is a close one, although a larger sample of Cordilleran var. *Blakei* has shown since Rydberg's day that the calyx-teeth vary in length more than was thought, while the color of the hairs in the inflorescence is as always a fallible and superficial character, the common color in var. *Fernaldi* being black or predominantly black as in other forms of its species. A relatively compact raceme and leaflets pubescent above at least near the margins, sometimes over the whole surface, further distinguish var. *Fernaldi* from short-stipitate var. *minor* of the Rocky Mountains. In the eastern form of var. *minor* and in other varieties found in New England, the stipe of the pod is longer.

Because of its pale pubescence and inconspicuous stipe concealed by the marcescent calyx, the typus of var. *Fernaldi* is highly suggestive of some forms of *A. eucosmus*, for which

Fernald himself mistook it, and from which Rousseau (1933, p. 38) has suggested that it arose by mutation. Rydberg stated that it differed from *A. eucosmus* in its longer and more acute pod and larger flower, but both can be matched closely for size and shape by some Cordilleran material of *A. eucosmus* (cf. *Moodie 50,* NY), and I can find no firm distinction other than the development in var. *Fernaldi* of the definite stipe. In the material of var. *Fernaldi* from the coast of Newfoundland the stipe is a little longer and better developed, and these populations are certainly part of the *A. Robbinsii* complex. According to Rousseau (1933, p. 39) the earliest collection of the Fernald milk-vetch (Labrador, without locality, *Miss Brodie*) dates back to the year 1863.

7g. Astragalus Robbinsii var. Harringtonii

Of moderate stature, the ascending stems (1) 1.5–3.5 dm. long; *leaves* 4–7.5 (10) cm. long, with 9–15 leaflets 5–23 mm. long, villous-pilosulous beneath with fine, loosely spreading or ascending, straightish, gray (sometimes partly fuscous or black) hairs up to 0.6–0.8 mm. long, either glabrous or thinly strigulose above; *peduncles* 6.5–15 cm. long; *racemes* rather densely 9–20-flowered, the axis little elongating, 1.5–3 (4) cm. long in fruit; calyx 6.1–8 mm. long, the tube 3.5–4.2 mm., the teeth 2.4–3.8 mm. long; *petals* pale purple or bluish-lavender; *banner* 9.5–11.5 mm., keel 7–7.6 mm. long; *stipe* of the pod 1.2–3 mm. long, the body subsymmetrically ellipsoid, 1.2–1.5 cm. long, 4–6 mm. in diameter, sometimes a little turgid, the valves densely villosulous with black hairs up to ± 0.5 mm. long, the septum relatively broad but incomplete, 1–1.6 mm. wide; *ovules* 6–8.—Collections: 8 (o); representative: *J. P. Anderson 872* (US), *1787* (NY); *Lt. York 113* (CAS, DS, MO, TEX); *Frohne 49–52* (DS); *Mrs. E. P. Walker 1058* (GH, US).

Gravelly and turfy shores and river banks at low elevations, apparently uncommon, coastal southern and southwestern Alaska, from Glacier Bay westward to Goodnews Bay; reported from Kotzebue Sound (Hultén, 1943, p. 1087).—Map No. 5.—Late May to August.

Astragalus Robbinsii var. Harringtonii (Rydb.), stat. nov., based on *Atelophragma Harringtonii* (George L. Harrington, in Alaska with U. S. Geological Survey) Rydb. in Bull. Torr. Club 55: 126. 1928.—"Alaska: Limestone ridge, Goodnews Bay, *Harrington 60* (type . . . flower), also at Matanuska, July 20, 1922, *J. P. Anderson 1787* (fruit . . .)"—Holotypus, collected July 14, 1919, US!—*Astragalus Harringtonii* (Rydb.) Hult., Fl. Alaska & Yukon 1087, map 817. 1946. *A. Harringtonii* Cov. & Standl. ex Rydb., l.c., in syn.

The Harrington milk-vetch is the form of *A. Robbinsii* most nearly deserving specific rank. The long, loose, and dense vesture of the lower leaf-surface, the relatively short and compact racemes, the long calyx-teeth, and wide septum within the pod form an exceptionally strong combination of characters in the context of the *Oroboidei.* However no single character of itself provides an infallible criterion, and whether one may prefer to emphasize or belittle the relationship to *A. Robbinsii* sens. lat. there can be no question that it is a close one. Rydberg described the flower as larger than that of related species of *Atelophragma,* but the petals are in reality no longer than in many examples of Cordilleran and eastern var. *minor.* Hultén (l.c.) accepted *A. Harringtonii* only hestitantly as specifically distinct from *A. Macounii* (our var. *minor*), of which he thought it might prove to be a coastal phase distinguished by a beakless pod and leaves more densely pubescent beneath and "punctuated" above. There is, however, no real difference in the form of the fruit; and the minutely whitish-tuberculate leaf-surface, although especially noticeable in var. *Harringtonii,* can be observed in less pronounced form in other varieties of *A. Robbinsii.* Mention has already been made of a plant found on the shores of Glacier Bay, apparently sympatric with genuine and typical var. *Harringtonii,* in which the thin pubescence and long stipe of var. *minor* (in its more northern Rocky Mountain and Alaskan phases) is combined with the long calyx-teeth and wide septum of var. *Harringtonii.* The latter has been interpreted provisionally as an outlying and somewhat aberrant form of var. *minor;* but whatever its real taxonomic status may be, it serves to tie var. *Harringtonii* firmly back into the *A. Robbinsii* complex.

The locality-record as listed by Rydberg needs some correction. The plant from Glacier Bay (*Anderson 1261,* US) represents the ambiguous var. *minor* mentioned in the last paragraph. The collection from "Kobuls" (= Kokuk) River *(Palmer 658)* is a robust form of *A. alpinus.* The Schrader plant from John River (US) is a *Hedysarum.*

V. Sectio HEMIPHRAGMIUM

Perennial, ours caulescent, with taproot and superficial root-crown or shortly forking caudex (this sometimes buried in talus); *vesture* basifixed; *stipules* ± dimorphic, the lower ones large, broad, obtuse, several-nerved, early becoming papery, fully amplexicaul but either free or shortly connate, the upper ones narrower, ± semiamplexicaul; *leaves* imparipinnate, with ± 7–17 articulate leaflets; *flowers* loosely or subcompactly racemose, declined, in ours rather small, the banner 7.5–14.5 mm. long; *pedicels* in fruit little thickened, tardily disjointing with the ripe fruit or persistent; *calyx-tube* campanulate; *petals* in ours whitish or cream-colored often ± suffused with lilac or purple-veined, regularly graduated (but the wings sometimes nearly as long as the banner), the wings cleft at apex into 2 unequal lobes, the blunt keel-tip maculate; *pod* pendulous, stipitate, persistent, the body asymmetrically elliptic in profile and laterally compressed, or variably inflated, sometimes bladdery, commonly a little arched downward (the ventral suture the more strongly convex), the papery valves inflexed as a narrow, hyaline septum (this rarely obsolete); *dehiscence* apical and downward through the length of the ventral suture, the valves finally explanate; *ovules* (in ours) 8–15.—Spp. ± 10, of alpine Europe, interior montane Asia (where most numerous), north into arctic Siberia, and arctic and temperate North America, 2 with us, spp. of dry but cool soils and climates (Alaska to Quebec, south in the Rocky Mountains to southern Colorado).

ASTRAGALUS sect. HEMIPHRAGMIUM (C. Koch) Bge., Astrag. Geront. 1: 21. 1868, emend. Gontsch. in Fl. U. R. S. S. 12: 62. 1946, based on *Phaca* sect. ("Rötte") *Hemiphragmium* C. Koch, Fl. Germ. Helv. 180. 1837.—Sp. lectotypica (by implication, the second of the original two being typus of sect. *Komaroviella* Gontsch., 1946 = our sect. *Astragalus*): *Phaca australis* L. = *A. australis* (L.) Lamk.

Phaca sect. *Epiphragmium* Turcz. in Bull. Soc. Nat. Mosc. 25: 737. 1842.—Sp. unica: *P. arenaria* Pall. = *A. chorinensis* Bge.

Astragalus sect. *Phacaeformes* Turcz. in Bull. Soc. Nat. Mosc. 25: 760. 1842, p.p.—Sp. lectotypica: *A. phacaeformis* Bge. = (fide Gontsch., 1946, p. 65) *A. vaginatus* Pall.

Atelophragma Rydb. in Bull. Torr. Club 32: 660. 1905.—Generitypus: *A. aboriginum* (Richards.) Rydb. = *Astragalus aboriginum* Richards.—*Atelophragma* sect. *Glabriuscula* Rydb. in Bull. Torr. Club 55: 120. 1928, the typical section.

Astragalus sect. *Hemiphragmium* subsect. *Trigoni, Subcompressi,* & *Inflati* Gontsch. in Fl. U. R. S. S. 12: 64, 65, 70. 1946.

The sect. *Hemiphragmium* was designed in the first place to accommodate two European species, *A. australis* (L.) Lamk. and *A. alpinus* L., in which the fruit was pendulous, stipitate, and thin-textured as in *Phaca*, but was semibilocular and thus failed to fit neatly into the Candollean classification of the astragaline tribe. The section was taken up by Bunge (1868) and greatly enlarged to include numerous Asiatic relatives of the original pair of species and the almost equally numerous *Oroboidei* or close kindred of *A. norvegicus* Grau. With additions made in modern times, the section as conceived by Bunge became heterogeneous and unwieldly, and its division by Gontscharov into several natural groups seems justified. In the process of dismemberment, a new sect. *Komaroviella* was proposed for *A. alpinus*, leaving *Hemiphragmium* typified by *A. australis*. The latter is closely related to our *A. aboriginum*, forming with it an intricate complex of circumboreal forms.

The sections proposed by Turczaninow in *Phaca* and *Astragalus* were based on species again closely related to *A. australis;* but the *Phacaeformes* differed in the trigonously rather than laterally compressed fruit, while that of *Epiphragmium* is swollen and bladdery. The *Phacaeformes* included, in addition to *A. vaginatus*, all of the principal types of *Hemiphragmium* sens. Bunge (*A. alpinus, A. oroboides,* and *A. australis*) and thus foreshadowed the scope of *Hemiphragmium* as accepted until recent years. The section was further broken up by Gontscharov into three subsections defined in terms of the pod's inflation and compression, but this formal rearrangement would separate into different series the extremely close relatives *A. aboriginum*, technically of subsect. *Subcompressi*, and *A. Cottoni*, of subsect. *Inflati*, and is probably not illustrative of real affinities.

The American members of sect. *Hemiphragmium* (sens. restr.) known a century ago,

A. aboriginum and *A. glabriusculus,* were placed by Gray (1864, p. 203) in his *Oroboidei veri,* a group equivalent to Bunge's sect. *Hemiphragmium* in the most comprehensive sense. The same pair of species, together with the lately discovered *A. Cottoni,* were referred by Jones (1923, p. 135) to an even more inclusive sect. *Alpini* (based on *A. alpinus* Sheld., non L.) as loosely defined as *Phaca* of XIX century texts, that is *Phaca* of DeCandolle but not Linnaeus. The genus *Atelophragma* was designed to serve the same purpose as *Hemiphragmium* and was divided by Rydberg into sections corresponding with those recognized independently by Gontscharov. The sect. *Glabriuscula* Rydb. is merely the New World segment of sect. *Hemiphragmium* sens. restr.

The core of sect. *Hemiphragmium* is doubtless related more or less closely to all the groups formerly contained within its ample compass, but it is especially near to sect. *Oroboidei,* from which it is rather arbitrarily separated because of the lobed rather than obtuse or shallowly emarginate wing-petals, a character which is known to fail in the case of the European *A. australis* var. *Gerardi* (Vill.) Jka. Despite the lack of strong differential characters present in all the species, there can be no doubt that the components of each section more nearly resemble each other than any one member of the other group, a fact which has been observed independently in America and the Old World. Taxonomically, sect. *Hemiphragmium* is one of the most difficult groups of *Astragali,* one which cannot be studied satisfactorily from herbarium specimens alone. It still requires careful revision on a circumpolar basis.

Key to the American Species of sect. Hemiphragmium

1. Pod ± strongly compressed laterally, at maturity decidedly two-sided and bicarinate by the sutures, but the faces varying from almost flat to low-convex, the body not or scarcely inflated, 3.5–6.5 (7) mm., or in Alaska sometimes up to 9 mm. in diameter when pressed; widespread, but not in the Olympic Mountains of Washington ..... 8. *A. aboriginum*

1. Pod only a little compressed laterally, the body strongly inflated, with high-convex lateral faces, 7–11 mm. in diameter when pressed; Olympic Mountains, w. Washington ..... 9. *A. Cottoni*

8. Astragalus aboriginum

Perennial, with a stout woody taproot and (in mature plants) a congested or ± knotty, pluricipital caudex, very variable in stature and pubescence, the stems and herbage varying from green and almost glabrous to densely silky-strigose, villous, or villous-tomentulose, the hairs straight and appressed, or straight and spreading, or incumbent, or curly, the longest up to 0.2–0.8 mm. long, the leaflets either equally pubescent on both sides or medially glabrescent to quite glabrous above; stems several or numerous, 0.2–2.6 dm. long, erect and ascending in clumps, or decumbent with incurved-ascending tips, or diffuse and trailing, simple or nearly so; *stipules* (1) 2–7 (10) mm. long, the large, approximate or loosely imbricated lower ones ovate, obovate, rhombic-obovate, or suborbicular, purplish becoming papery and brownish, several-nerved, amplexicaul and usually wider than the stem, the contrapetiolar margins in contact but either free or shortly connate (rarely united for over ½ their length), the median and upper ones narrower, subherbaceous, lanceolate or narrowly oblong, obtuse or acute, semiamplexicaul and usually about ½ as wide as the stem; *leaves* 1–7 (10) cm. long, all sessile or rarely all petioled, with 7–15 lance-, oblong-, or linear-elliptic, sometimes lance-oblong or almost truly linear, acute or obtuse, flat or marginally involute leaflets 3–27 (35) mm. long, 1–7 mm. wide; *peduncles* erect or incurved-ascending (sometimes eventually humistrate from diffuse stems), 2–12 cm. long, as long or longer than the leaf; *racemes* (2) 6–30-flowered, compact at early anthesis but nearly always quickly loosening, the axis (1) 2–11 cm. long in fruit, the pods commonly secund; *bracts* membranous or membranous-margined, narrowly lanceolate or sublinear, 1.2–5 mm. long; *pedicels* at anthesis ascending, 0.8–2.2 mm. long, in fruit arched outward, recurved, or deflexed, (1.2) 1.5–3.5 mm. long; *bracteoles* 0; *calyx* (3.7) 4.2–6.4 (9) mm. long, loosely strigulose to densely villous-pilosulous with black, fuscous, and usually some or many (all) white hairs,

the subsymmetric disc 0.4–1.1 (1.6) mm. deep, the tube (2.1) 2.7–3.9 (5) mm. long, (1.8) 2–3 (3.5) mm. in diameter, the subulate teeth 1–3 (4) mm. long, the whole becoming papery, marcescent unruptured; *petals* whitish (or when first expanded flesh-pink) or cream-colored, the banner commonly veined and sometimes distally suffused with lavender or brownish-purple, the keel-tip (usually prominently) maculate; *banner* recurved through 40–50°, broadly oblanceolate, elliptic-oblanceolate, or obovate-cuneate, openly notched, 7.5–12.6 (14.5) mm. long, 4–7.4 (8) mm. wide; *wings* 7–11.8 (12.4) mm. long, the claws 3–5 mm., the narrowly oblong or oblanceolate, nearly straight blades 5–8.1 (9.3) mm. long, 1.7–2.7 (3.4) mm. wide just below the lobed apex; *keel* (6.1) 6.7–9.6 mm. long, the claws 3–4.6 (4.9) mm., the half-obovate blades (3) 4–5.1 (5.6) mm. long, (1.7) 2–2.8 (3.2) mm. wide, incurved through 75–100° to the rounded apex; *anthers* (0.3) 0.35–0.55 (0.6) mm. long; *pod* pendulous (or if humistrate falling at random angles), stipitate, the slender stipe 2.5–8 mm. long, the body obliquely, rarely subsymmetrically narrow-elliptic (linear-oblong) in profile, nearly always slightly decurved, the ventral suture convex and the dorsal one straight or a trifle concave, 1–2.6 (3.1) cm. long, 3–6 (7) mm., or in Alaska sometimes 6–9 mm. in diameter, usually tapering (or when broad more abruptly contracted) into the stipe, cuneate or cuneately tapering and short-acuminate at apex, laterally compressed, bicarinate by the prominent but filiform sutures, the faces at first nearly flat becoming ± distended and low-convex, sometimes a little tumid when fully mature, the thin, greenish but commonly red- or purple-tinged or -dotted (but not mottled), glabrous or less often strigulose valves becoming stramineous, translucent, finely reticulate, inflexed as a very narrow, sometimes obscure (rarely obsolete) septum 0.1–0.6 mm. wide; *ovules* 8–16; *seeds* brown, ocher-brown, or greenish, sometimes purple-speckled, smooth but dull, 2–2.9 mm. long.—Collections: 151 (vii); representative material cited in the discussion.

Stony shores, river bluffs, rock slides, exposed crests, and stony or turfy mountain slopes and meadows, in the Rocky Mountains coming out into the parks and openly wooded foothills and on the northern prairies to river bluffs and badlands, in dry or moderately moist (but not waterlogged or permanently moist) soils, apparently most abundant on calcareous bedrock but found also on granites, schists, and other formations, near sea level at its north- and eastward limits, up to 11,000 feet in the western mountains, locally plentiful in the Rocky Mountains from northeastern British Columbia to southern Colorado, west to the Wallowa Mountains in northeastern Oregon, the East Humboldt Mountains in northeastern Nevada, and the Wasatch in central Utah, eastward interruptedly to the Black Hills of South Dakota, western North Dakota, and across southern Canada to Manitoba and (very interruptedly) southern Quebec (Lake Timiskaming and Gaspé Peninsula); also locally abundant in the upper Yukon Valley, Yukon; and in the tundra zone and barren grounds of Alaska and District of Mackenzie from near Point Hope east to southeastern Victoria Island (ca. long. 104° W.), south in Alaska to the Alaska Range, in Yukon to the Ogilvie Mountains, and in Mackenzie to Great Bear Lake and the Mackenzie Valley; eastern Siberia.—Map No. 6.—Late May to August.

ASTRAGALUS ABORIGINUM, (of the Cree and Stone Indians, who gathered the root as a spring vegetable) Richards. in Frankl. Jour., Append. 746. 1823 (*"aboriginorum"*).—"Sandy plains in the neighbourhood of Carlton," i.e., on the North Saskatchewan River above Prince Albert.—Presumed holotypus, labeled "N. America, 1819–22, *Richardson*," BM! isotypus, labeled "Carlton House, *Richardson 285*," K (but ovary glabrous)! A spm. labeled "N.-W. America, Franklin Exped., Dr. H[ooker]," GH, ex herb. Boston Soc. Nat. Hist. is perhaps another isotypus.—*Phaca aboriginum* (Richards.) Hook., Fl. Bor.-Amer. 1: 143, tab. LVI. 1831 (*"Aboriginorum"*). *Tragacantha aboriginum* (Richards.) O. Kze., Rev. Gen. 942. 1891.

Homalobus aboriginum (Richards.) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 246. 1900 *("aboriginorum"). Atelophragma aboriginum* (Richards.) Rydb. in Bull. Torr. Club 32: 660. 1905.

Phaca glabriuscula (rather glabrous) Hook., Fl. Bor.-Amer. 1: 144. 1831.—"Vallies of the Rocky Mountains, *Drummond.*"—Holotypus, K!—*Astragalus glabriusculus* (Hook.) Gray in Proc. Philad. Acad. 1863, p. 60. 1863, by implication, & in Proc. Amer. Acad. 6: 204. 1864. *Tragacantha glabriuscula* (Hook.) O. Kze., Rev. Gen. 945. 1891. *Astragalus aboriginum* var. *glabriusculus* (Hook.) Rydb. in Contrib. U. S. Nat. Herb. 3[1] (Fl. Black Hills): 492. 1896. *Homalobus glabriusculus* (Hook.) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 246. 1900. *Atelophragma glabriusculum* (Hook.) Rydb. in Bull. Torr. Club 32: 660. 1905 *("glabriuscula").*

Astragalus glabriusculus var. *major* (larger) Gray in Proc. Philad. Acad. 1863, p. 60. 1863.—"116. in the mountains, at middle elevations."—Holotypus, collected by Hall & Harbour in the Colorado Rocky Mountains, in lat. 39–41°, in 1862, GH! isotypi, K, NY!—*A. glabriusculus* var. *spatiosus* (spacious) Sheld. in Minn. Bot. Stud. 1: 156. 1894, a superfluous substitute. *A. spatiosus* (Sheld.) A. Hell., Cat. N. Amer. Pl., Ed. 2. 7. 1900.

Astragalus Forwoodii (William Henry Forwood, 1838–1914, sometime Surgeon-General, U.S. Army, naturalist with Gen. Sheridan's expedition, 1879–82) Wats. in Proc. Amer. Acad. 25: 129. 1889.—"Black Hills of S. Dakotah . . . Dr. W. H. Forwood, U. S. A., May, 1887."—Holotypus, GH!

Astragalus Richardsonii (Sir John Richardson, 1787–1865, surgeon-naturalist with the Franklin Expedition) Sheld. in Minn. Bot. Stud. 1: 126. 1894, a new name for *A. vaginatus* (sheathing, of the stipules) sensu Richards. ex Hook., Fl. Bor.-Amer. 1: 149. 1831 (non Pallas, 1800, tab. 36).—"Woody country between lat. 54° and 64°, *Dr. Richardson.*"—No holotypus certainly identified as such; spm. authent., labeled simply *"A. vaginatus,"* BM! the spm. at GH labeled "284. *Astragalus vaginatus.* Richardson's Arctic Plants" (ex herb. Lowell.) is probably a duplicate of the preceding.

Atelophragma lineare (linear, of the leaflets) Rydb. in Bull. Torr. Club 40: 50, 1913.—"YUKON TERRITORY: Foot of Lake Lebarge, 1899, *J. B. Tarleton 34b. . .* "—Holotypus, collected June 23, 1899, NY! isotypus, US!—*Astragalus linearis* (Rydb.) A. E. Porsild in Rhodora 41: 250. 1939.

Astragalus aboriginum var. *fastigiorum* (of summits) Jones, Rev. Astrag. 135. 1923.—"The type is my material from Mt. ["Mr."] Haggin, Montana."—Holotypus, collected by Jones on Mt. Haggin near Anaconda at 8500 ft., July 20, 1905, POM (2 sheets)! isotypi, GH, NY!

Atelophragma wallowense (of the Wallowa Mountains) Rydb. in Bull. Torr. Club 55: 122. 1928.—"The type was collected on the Wallowa Mountains, Oregon, July 28, 1899, *Cusick 2267* . . . "—Holotypus, GH! isotypus, P!—*Astragalus Forwoodii* var. *wallowensis* (Rydb.) Peck, Man. Pl. Ore. 447. 1940, & in Madroño 6: 135. 1941.

Atelophragma Herriotii (William Herriot, 1870–1930) Rydb. in Bull. Torr. Club 55: 123. 1928.—"MANITOBA: Qu'Appelle River, *Macoun & Herriot 70479* . . . "—Holotypus, collected at mouth of Qu'Appelle River, June 28, 1906 *(Herb. Geol. Surv. Canad. No. 70,479),* NY! isotypus, CAS!

Astragalus scrupulicola (dwelling on "sharp and angular pencil-like talus") Fern. & Weath. in Rhodora 33: 238, fig. 1. 1931.—"Gaspé County, QUEBEC: . . . Calcareous slaty talus, southern slope of Mt. St. Pierre, July 5, 1931 (flowers and young fruit), *Fernald, Weatherby & Stebbins, No. 2455* (TYPE in Gray Herb.) . . . "—Holotypus, GH!

Astragalus aboriginum var. *Muriei* (Olaus Johan Murie, b. 1889, zoologist with Bur. of Biol. Surv., collected extensively in Alaska and Yukon in 1920–36) Hult., Fl. Alaska & Yukon 1080. 1947.—"Central Yukon R. distr.: Porcupine R., 45 miles from the mouth, MURIE 2162 . . . "—Holotypus (herb. Hult.), not examined.

Astragalus Lepagei (Rev. Ernest Lepage, 1905–) Hult., Fl. Alaska & Yukon 1761, fig. 4. 1950.—"Arctic Coast distr.: Umiat, July 29, 1948, LEPAGE 23601 (type . . .)."—Holotypus (herb. Hult.), not examined.

Because of variations in stature, vesture, and amplitude of the foliage, the Indian milk-vetch, *A. aboriginum,* cannot be characterized in a few succinct words. Leading features are the large, veiny, obtuse stipules at base of the stems and the toothed wing-petals which distinguish members of sect. *Hemiphragmium* from habitally similar and sympatric *Oroboidei.* The nodding flowers vary somewhat in size but hardly at all in shape or relative proportions of the parts; they are usually conspicuously bicolored on account of the blot on the keel-tip, which often becomes more intensely colored when dry. There is a wide range of variation in length and orientation of the stems, much of it clearly correlated with accidents of habitat and exposure. The pod is almost uniformly half-elliptic in profile with nearly straight dorsal and convexly arched ventral suture, so that it appears to be arched a little downward. Its stipe varies from about as long to over twice as long as the tube of the calyx, and the body varies

in width from 3.5 to 6 mm., or in the far Northwest up to 9 mm. in diameter. Nevertheless the flowers and fruits of the Indian milk-vetch are everywhere so much alike in fine detail that it seems certain we are dealing with only one specific type, however variable its component parts may be in other features.

The Indian milk-vetch (with its close relative *A. Cottoni*) is isolated in our flora, but has several close kindred in Eurasia, notably *A. australis* (L.) Lamk. Polunin (Circumpolar Arctic Flora 287. 1959) has treated the latter and at least the boreal manifestations of *A. aboriginum* as forming an aggregate species, and there is much to be said in favor of this view. The problem of specific limits in sect. *Hemiphragmium* involves, however, a whole complex of forms widely dispersed from the Pyrenees and Carpathians across northern Asia into Mongolia and Siberia and a number of proposed segregates such as *A. Tugarinovii* Basilevsk., *A. Kaufmannii* Kryl., and *A. pseudoaustralis* F. & M., known to me only from descriptions or totally inadequate specimens. There is no alternative but to postpone study of this and attendant nomenclatural questions and limit the field of inquiry to what must be called *A. aboriginum* in America. A discussion of our plants may be divided profitably into two parts, one dealing with the Indian milk-vetches of the Rocky Mountains and southern Canada generally, one with the Arctic and Alaskan types.

Astragalus aboriginum in the United States and Canada south of lat. 60° N.

With few exceptions the synonyms already cited are based on plants from this area, and they have arisen through independent observations of the perplexing diversity in type and distribution of the vesture and in width of the leaflets varying from linear-elliptic or almost exactly linear to broadly or subrhombically elliptic. The pubescence of the leaves, stems, and inflorescences, often black or fuscous distally, fluctuates from sparse or almost lacking to quite dense, and the herbage from bright green to cinereous or even silvery-canescent; moreover, whether closely or sparsely set, the hairs vary from straight and appressed to straight and spreading or incumbent and curly. Whatever sort of hair predominates, the leaflets (of whatever shape) may be either glabrous or strigulose on the upper face, and the pod varies independently of other factors from glabrous to strigulose. Combinations of these variable characters have served from early times to distinguish varietal and specific segregates of *A. aboriginum,* although these have all been recognized as close to the prototypical Indian milk-vetch. It so happened that as soon as one combination of variables was accepted as taxonomically significant, logic compelled an equally respectful consideration of its peers. Granted that shape of leaflets, presence or absence of hairs on the upper leaf-surface and the pod, and appressed or spreading vesture are racially correlated, we are presented with the theoretical possibility of sixteen combinations. For purposes of analysis and comment, we might visualize these combinations by means of the following diagrammatic key:

	Pod glabrous	Pod hairy
1. Leaflets elliptic		
2. and pubescent above		
3. with curly or spreading hairs	*a*	*aa*
3. with appressed or subappressed, straight or nearly straight hairs	*b*	*bb*
2. and glabrous above		
4. the vesture beneath of curly or spreading hairs	*c*	*cc*
4. the vesture beneath of appressed, nearly straight hairs	*d*	*dd*
1. Leaflets linear or nearly so		
5. and pubescent above		
6. with curly or spreading hairs	*e*	*ee*
6. with appressed or subappressed, straight or nearly straight hairs	*f*	*ff*
5. and glabrous above		
7. the vesture beneath of curly or spreading hairs	*g*	*gg*
7. the vesture beneath of straight or nearly straight, subappressed hairs	*h*	*hh*

In the area under discussion, all theoretically possible combinations with the exception of that designated as *cc* have been found at least once, and it would be rash to assume that

Map No. 6. Canada and United States. Range (in America) of ▼ *A. aboriginum*; and

Cottoni.

the one still missing does not exist. The forms are far from equally common. The most widely dispersed types of *A. aboriginum* are those with relatively broad leaflets; they extend over the whole species-range and also represent the species in all the known outlying or marginal stations. Among the presumably primitive broad-leaved forms, the majority by far have loosely pubescent foliage (and the majority of these leaves pubescent on both sides) together with a glabrous pod. But in the Rocky Mountains plants differing only in their shorter, appressed, and often sparser vesture (with leaflets more often glabrous above) are encountered within the same range and in the same environments. A less common combination is that of broad leaflets and a pubescent pod, although these features are known to occur either with appressed or with spreading vesture. The group of forms with linear or linear-elliptic leaflets is of comparatively northern and northwestern range, extending from Manitoba to North Dakota, Alberta, and very rarely to Montana and the Black Hills, and recurs also in Alaska. In this group strigulose and villosulous foliage are of about equal frequency, but a glabrous pod, as always, is much the commoner. Although it is generally possible to assign a given plant to one of the lettered forms defined in the key, there are transitional individuals; and in many colonies there is variation from plant to plant, especially in pubescence characters. The following mixtures, which could probably be added to by means of mass-collections, have been found in sets of duplicate herbarium specimens, several of them on single sheets (the type-collections of *A. Forwoodii, A. glabriusculus* var. *major, A. aboriginum* var. *fastigiorum,* and *Atelophragma wallowense* among them): *a* + *b*; *a* + *d*; *a* + *b* + *d*; *a* + *c*; *b* + *d*; *bb* + *d*; *c* + *d*; *d* + *dd*; *d* + *e*; *d* + *h*; *e* + *f*; *e* + *g*; *e* + *ee*; *f* + *h*; *h* + *ff*; and *b* + *d* + *dd*. Obviously many populations of *A. aboriginum,* whether broad- or narrow-leaved, are highly unstable as to type, distribution, and density of the pubescence, although examples of glabrous and pubescent pods in the same colony are few. Shape of the leaflets, which might be thought superficial in theory, is more nearly fixed within the average population, although in a review of all the material available it is a simple matter to trace an intergradient series from the broadest elliptic to the narrowest linear type. In the circumstances there can be no advantage in maintaining any of the segregates proposed in ignorance of the complexities involved.

Astragalus aboriginum in Alaska, Yukon, and Mackenzie

The arctic and subarctic races of *A. aboriginum* introduce three new features, petioled stem leaves, larger flowers, and broader pods than found in the Rocky Mountains. Southward from the 60th parallel, the leaves of the Indian milk-vetch are all sessile or nearly so, and the flowers are always small, with banner 7.5–12.5 mm. long. Northward from upper Yukon Valley, the leaves are often slender-petioled, and the flowers are occasionally much larger, with banner up to 14.5 mm. long. As in the more southern area, the pod is much more often glabrous than strigulose, but it is more variable in size, sometimes reaching a width of 6–9 (as opposed to an average 3.5–6) mm., and furthermore it is sometimes less strongly compressed and incipiently bladdery. Several pubescence types occur in the Northwest, but none seem to be correlated with shape of leaflets or with size of the flower-parts or fruits. In the upper Yukon Valley, the leaflets are prevailingly linear or nearly so, but the leaves vary from sessile to petiolate. Above the Arctic Circle, the leaflets are usually of a broad type, and the leaves are most often petioled, but neither of these characters is more than dominant in any region which might reasonably be expected to harbor a distinct or endemic race. Three types, fully intergradient but at the extreme point of development easily recognized, can be made out in the material from Alaska, Yukon, and Mackenzie District. The first, locally abundant in the upper Yukon Valley, closely mimics the linear-leaved forms found in the foothills of the Alberta Rocky Mountains (variants *e, f,* and *g*); it has developed stems (± 5–7 visible internodes), mostly sessile leaves, small flowers, and a strongly compressed, flat-sided pod. In the same area (but whether ecologically separated or not is unclear) there occurs a form with petioled leaves and sometimes more turgid pod. The latter corresponds with *Atelophragma lineare* and leads into what might be called the Behringian variant, which is typically developed the length of the Brooks Range in Alaska, extending south to the Alaska Range, east to the Ogilvie Mountains in central Yukon, and west an unknown distance (possibly as far as the Yenisei River) into Siberia. The Behringian variant is a broad-leaved type, usually of slender, decumbent growth and lowly stature (± 3–4 visible internodes), and is characterized further by strongly connate lower stipules, petioled leaves, and small flowers. The pod is variable in size but seems to average a little broader (at least in relation to its width) than that of the Cordilleran forms of *A. aboriginum* and is sometimes perceptibly swollen with convex faces. The third boreal American type resembles the last in its low stature but is coarser in all its parts, has gray-pubescent (usually gray-villosulous) foliage and, on the average, substantially larger flowers. It is typically developed north of the tree line from the east end of the Brooks Range east to Victoria Island and south over the tundra to Great Bear Lake; it might be called the Mackenzie variant. It has been identified with *A. Richardsonii*

Sheld., but this is probably a mistake, for the original *A. vaginatus* of Richardson, according to Hooker's description and the specimens at BM and GH, is apparently equivalent to form *d* as defined above in the schematic key. The type-locality of *A. Richardsonii,* in "woody country between 54° and 64° N," also suggests one of the more southern Canadian rather than one of the tundra phases of the Indian milk-vetch. There remain other isolated gatherings which fit into none of these categories exactly. The form described as *A. Lepagei* is one of these, a relatively tall, glabrescent plant with large flowers and broad pods; but copious typotypes from Umiat *(Lindsay 2359, Wiggins 12,883, K. L. Chambers 197)* show much variation in length of the (mostly very narrow) leaflets and in width (5–9 mm.) of the strongly flattened pod. The typus of var. *Muriei,* described as having leaflets glabrous above but a pubescent pod, has not been examined and has not been equated with any particular variant.

The Behringian variant of *A. aboriginum* scarcely differs from some European and Asiatic material of *A. australis.* It was apparently included by Gontscharov (1946, p. 66) in his concept of an arctic-alpine *A. australis* widely dispersed across northern Eurasia, and its villosulous phase seems (e descr.) identical with or extremely close to *A. Tugarinovii* N. Basilevsk. (in Not. Syst. Herb. Hort. Petrop. 5: 69. 1924.—"in prov. Enniseisk. Goltschicha.") which Gontscharov has reduced to synonymy. On the other hand the plant of the Brooks Range passes, by scarcely perceptible steps, through the intergradient *Atelophragma lineare* into the ordinarily taller plant known traditionally in America as *A. aboriginum.* The taxonomy and nomenclature of the whole complex remain to be worked out in detail, but this can be achieved only on a circumpolar basis. The following summary of the American variants is offered as a stepping stone in the direction of the biosystematic revision which is required before many problems in sect. *Hemiphragmium* can be solved.

Summary of the American Variants of A. aboriginum

a. Leaflets elliptic, pubescent above and beneath, the vesture villosulous. Pod glabrous.—Rocky Mountains from Alberta to centr. Colorado, w. through centr. Idaho to the Wallowa Mountains, Oregon, the E. Humboldt Mountains, Nevada, and centr. Utah; Black Hills, South Dakota (= var. *fastigiorum,* p.p.; *Atelophragma wallowense,* p.p.).—Representative: *Hitchcock & Muhlick 11,169* (CAS, NY, WS, WTU), *10,883* (NY, SMU, WS, WTU, some mixed with *d*), *12,909* (RSA, WS, mixed with *c* and *b*); *Jones 51* (POM, NY); *Ripley & Barneby 8224* (CAS, GH, RSA, UTC, mixed with *b*), *10,390* (RSA). One spm. from s. Yukon (*Porsild & Breitung 10,689,* NY) technically referable here intergrades with *e.*

aa. Leaflets and pubescence as *a,* but pod pubescent.—Uncommon, Rocky Mountains from ± 56° N. in British Columbia s. to n.-w. Wyoming; s.-centr. Saskatchewan; Gaspé Peninsula, Quebec (= *A. aboriginum* sens. str., e descr.; *A. scrupulicola*).—Representative: *Raup & Abbe 3576* (NY); *F. J. Hermann 13,314* (RSA); *Breitung 15,704* (NY); *Fernald & Weatherby in Pl. Gray. Exsicc. 559.*—The robust form greatly isolated in Quebec and described as *A. scrupulicola* is closely matched by Dr. Hermann's cited collection from Alberta. The supposed differences in the auricles of the wing-petals between a *single flower* from Gaspé and the *illustration* of *A. aboriginum* hardly deserved the emphasis accorded by Fernald.

b. Leaflets elliptic, pubescent above and beneath, the vesture appressed. Pod glabrous.—Often with *a,* but less widely dispersed and less common, s. Alberta and s. British Columbia to n.-w. Wyoming.—Representative: *Hitchcock & Muhlick 11,973* (NY, RSA, WS), *12,909* (NY, RSA, WS, some mixed with *a*).

bb. Leaflets and pubescence as *b,* but pod pubescent.—Foothills of the s. Alberta Rocky Mountains, apparently rare.—Representative: *Brinkman 3545* (NY); *Moodie 48* (NY, mixed with *d*).

c. Leaflets elliptic, villosulous beneath, glabrous above. Pod glabrous.—Montana to Colorado, w. to the Wallowa Mountains, Oregon, e. to the Black Hills, South Dakota; Fort Saskatchewan, Alberta (= *A. Forwoodii,* p.p.; *Atelophragma wallowense,* but note that *a* and *d* also occur in the Wallowa Mountains).—Representative: *Hitchcock & Muhlick 10,883* (CAS); *Parry 2 in 1864* (CAS, NY); *Ripley & Barneby 8933* (RSA).

cc. Leaflets and pubescence as *c,* but pod pubescent. Unknown.

d. Leaflets elliptic, strigulose beneath, glabrous above. Pod glabrous.—Common in the Rocky Mountains of Montana, s. Alberta, and n.-w. Wyoming, less frequent s. to Colorado, n. to Peace River Valley, and e. to Saskatchewan and the Black Hills of South Dakota; s.-w. Quebec (= *A. glabriusculus* var. *major; A. Forwoodii,* p.p; *A. vaginatus* sensu Richards. *A. aboriginum* var. *fastigiorum,* a dwarf and diffuse, high mountain form; *Atelophragma wallowense,* p.p.).—Representative: *Raup & Abbe 3575* (NY); *Ledingham & Vip 2227* (USAS); *C. L. Hitchcock 15,880* (NY, RSA, SMU, WS, some mixed with *a*), *16,587* (NY, RSA, an almost glabrous state); *Rydberg 623* (NY); *Clokey, Bethel &*

Schmoll 4177 (CAS, NY, WS); *G. T. Robbins 528* (RSA); *Ripley & Barneby 8029* (CAS, NY, RSA).

dd. Leaflets and pubescence as *d*, but pod pubescent.—Of rare and sporadic occurrence, usually with *a*, *b*, or *d*, known only from Montana and from near Fort Saskatchewan, Alberta.—Representative: *W. E. Booth 52326, 52376* (RSA, mixed with *a*); *G. H. Turner 2420, 2481* (herb. F. J. Hermann.).

e. Leaflets linear, pubescent above and beneath, the vesture villosulous. Pod glabrous.—Rare, known only from upper Yukon Valley, Yukon, where it occurs with *f*.—Representative: *J. M. Gillett 3182* (CAS, mixed with *f*); *Gorman 1014* (ND; note that the duplicate at NY = *f*).

ee. Leaflets and pubescence as *e*, but pod pubescent.—Rare and sporadic, sometimes with *dd*, s. Manitoba to n.-e. British Columbia; Yellowstone Park, Wyoming.—Representative: *G. Branston*, from Lake Winnipeg, Manitoba (WIS); *Raup & Abbe 3576* (GH).

f. Leaflets linear, pubescent above and beneath, the vesture strigulose. Pod glabrous.—Rare and scattered, from Yukon to the Alberta Rocky Mountains; Cypress Hills, s. Saskatchewan; centr. Colorado (the typus of *Atelophragma lineare* is intermediate between this form and the Behringian variant).—Representative: *Eastwood 625* (CAS, GH); *Bourgeau* (from the Rocky Mountains) *in 1858* (GH); *Wolf & Rothrock 249* (GH).

ff. Leaflets and pubescence as *f*, but pod pubescent.—Known only from valley of Bow River, Alberta.—Representative: *Moodie 48* (NY, mixed with *h*).

g. Leaflets linear, glabrous above, villosulous beneath. Pod glabrous.—Rare, known only from neighborhood of Whitehorse, Yukon, where found with *e*.—Representative: *J. A. Kusche in 1916* (CAS, p.p.)

gg. Leaflets and pubescence as *g*, but pod pubescent.—Rare, known only from n.-e. British Columbia.—Representative: *Calder & Gillett 25,377* (NY).

h. Leaflets linear, glabrous above, strigulose beneath. Pod glabrous (= *Phaca glabriuscula* Hook.).—Occasional from the Bow River Valley, Alberta, to Montana, w. North Dakota, and the Black Hills of South Dakota, sometimes mixed with *f* or *ff*.—Representative: *McCalla 2132* (NY); *Ledingham 2399, 2438* (NY); *A. & E. Nelson 5456* (NY); *Moodie 48*, p.p. (NY).

hh. Leaflets and pubescence as *h*, but pod pubescent.—Rare and sporadic, Qu'Appelle River Valley, Manitoba; Yukon Valley, Alaska; n.-e. British Columbia; Mackenzie River Valley (*Atelophragma Herriotii; A. aboriginum* var. *Muriei*, e. descr.).—Representative: *J. Macoun 115* (GH); *Margaret E. Murie 22* (GH); *Calder & Gillett 27,354* (NY); *Porsild 16,653* (US).

The Mackenzie variant.—Leaflets mostly elliptic and villosulous on both sides, sometimes strigulose, sometimes glabrescent above; leaves mostly sessile; flowers larger than in the southern or Cordilleran forms mentioned hitherto, the calyx-tube mostly 4–5 mm. long, 3–3.5 mm. in diameter, the keel 8.4–9.6 mm. long; pod glabrous, up to 8 (9) mm. in diameter, strongly compressed (= *A. Richardsonii* auct. canad., vix *A. vaginatus* Richards. ex Hook.; *A. Lepagei* is in most respects intermediate between this and the next).—In tundra, lat. ± 66–70°, from e. end of Brooks Range, Alaska, e. to Great Bear Lake, and along the Arctic Coast and neighboring islands to Victoria Island, Mackenzie Territory.—Representative: *R. M. Chapman 169* (US); *W. I. Findlay 99a* (US); *Frits Johansen 310* (GH, NY, POM); *Cody & Ferguson 9982, 10,190* (DAO); *John Woodruff 170* (DAO).

The Behringian variant.—Usually slender and short-stemmed; leaflets elliptic, mostly glabrous above, either strigulose or villosulous beneath; leaves mostly petioled; flowers small (as in most Cordilleran forms), the calyx-tube 2.1–4 mm. long, 1.8–2.5 mm. in diameter, the keel 6–8 mm. long; pod glabrous, the body ± 1–2 cm. long, 3.5–7 mm. in diameter, sometimes turgid and the faces then convexly distended (*Atelophragma lineare* approaches this form).—Arctic shores, ascending to barren alpine ridges in the interior up to 4000 ft., n. and centr. Alaska (Brooks Range and Baird Mountains; McKinley Range) and centr. Yukon (Ogilvie Mountains), w. into Siberia, the w. limit not established.—Representative: *Galen Smith 2454* (NY), *2542* (ALA); *H. J. Thompson 1309* (GH, DS, US); *J. P. Anderson 5740* (GH); *Johnson, Viereck & Melchior 546* (DAO); *Calder & Gillett 26,092* (NY); *C. Wright* (from Arakamtchtchene Island) *ca. 1850* (GH, P).

9. Astragalus Cottoni

Habit of *A. aboriginum*, rather densely villosulous throughout with fine, shorter and curly, together with longer and nearly straight hairs up to 0.5–0.6 mm. long, the herbage cinereous, the leaflets pubescent on both sides but sometimes more thinly so and of a lighter green above, the inflorescence black-hairy; *stems*

several, decumbent and ascending 1–1.7 dm. long, arising from a root-crown or shortly forking caudex often buried for a space of 2–7 cm. in talus, simple or branched at 1–3 nodes preceding the first peduncle; *stipules* 2.5–6 mm. long, the lower ones broad, obtuse, fully amplexicaul, the lowest either united into a cuplike sheath or their contrapetiolar margins contiguous but free, the median and upper ones triangular-obovate or broadly lanceolate, all obtuse, several-nerved, glabrous or thinly pubescent dorsally; *leaves* (1.5) 2–5.5 cm. long, all but the lowest subsessile, with (9) 11–15 (17) rather crowded, elliptic-oblanceolate to linear-elliptic, acute or subacute, flat or loosely folded leaflets 4–16 mm. long; *peduncles* incurved-ascending, 3–6.5 cm. long, about as long or a little longer than the leaf; *racemes* 11–21-flowered, at first rather dense but loosening during anthesis, the axis elongating, 2–6 cm. long in fruit; *bracts* membranous becoming papery, purple-tinged, linear, linear-lanceolate, or -oblanceolate, 3–5 mm. long; *pedicels* slender, at first ascending, at length spreading or arched outward, at anthesis 1–1.7 mm., in fruit 1.2–2 mm. long, little thickened but persistent; *bracteoles* 0; *calyx* 7–8.4 mm. long, villosulous like the herbage with black or mixed black and white hairs, the subsymmetric disc 0.9–1.3 mm. deep, the membranous, pallid but purple-tinged tube 3.8–4.4 mm. long, 3–3.4 mm. in diameter, the subulate or lance-subulate teeth 3–4 mm. long; *petals* creamy-white, the banner veined and distally suffused with dull lavender, the keel-tip maculate; *banner* recurved through ± 50°, obovate-spatulate, shallowly notched, 10–12.2 mm. long, 6.6–7.8 mm. wide; *wings* 9.2–11 mm. long, the claws 3.6-5.2 mm., the linear-oblong or narrowly oblanceolate, slightly incurved blades 6.7–7.5 mm. long, 1.8–2.8 mm. wide, cleft at apex into 2 unequal lobes, the inner one ± twice as broad as the outer; *keel* 8.2–9.8 mm. long, the claws 3.8–4.7 mm., the half-obovate blades 5–6.1 mm. long, 2.2–2.8 mm. wide, incurved through 95–100° (rarely less) into the bluntly deltoid, sometimes subporrect apex; *anthers* 0.45–0.55 mm. long; *pod* loosely pendulous, stipitate, the slender stipe 3–5 mm. long, the body half-ellipsoid, bladdery-inflated but quite perceptibly compressed laterally, 2–2.5 cm. long, 7–9 (when pressed up to 11) mm. in diameter, the ventral suture convexly arched, the dorsal one straight or a trifle concave, the papery-membranous, glabrous, red-tinged valves becoming brownish or stramineous, subdiaphanous, delicately reticulate, inflexed as a hyaline septum ± 1 mm. wide; *ovules* 10–15; *seeds* brown, nearly smooth, 2.5–2.8 mm. long.—Collections: 8 (o); representative: *J. W. Thompson 7405* (NY, POM, WTU), *8771* (NY, WS, WTU), *9459, 10,071* (NY, WTU).

Open rocky crests and talus beneath subalpine cliffs, on granite, ± 4500–5500 feet, locally plentiful on the north slope of the Olympic Mountains (Mount Angeles; Hurricane Ridge), Clallam County, Washington.—Map No. 6.—Late June to August.

ASTRAGALUS COTTONI (John Storrs Cotton, *b.* 1875) Jones, Rev. Astrag. 135, Pl. 27. 1923, a legitimate substitute for *A. olympicus* (of Washington's Olympic Mountains) Cotton in Bull. Torr. Club **29**: 573. 1902 *("Olympicus")*, non *A. olympicus* (of Thessalian Olympus) Pall., 1800, nec *A. olympicus* (of Armenian Olympus) Bge., 1869.—"Olympic Mts., Clallam County, July, 1900, *A. D. E. Elmer.*"—Holotypus, *Elmer 2531*, WS! isotypi, NY, ORE, P, US!—*Atelophragma Cottoni* (Jones) Rydb. in Bull. Torr. Club **55**: 121. 1928.

The Cotton milk-vetch is the only astragalus known to occur in the Olympic Mountains, where it is apparently endemic. On account of its stipitate, inflated pod it was mistaken by Piper (Fl. Wash. 369) for *Phaca Hookeriana* (= our *A. Whitneyi* var. *Sonneanus*), but it differs in many important details, not least in the bidentate wing-tips and decurved, subunilocular (not symmetrically balloon-shaped, truly unilocular) fruit. It is very closely related to *A. aboriginum* sens. lat., resembling some villosulous Cordilleran phases of that species in every respect except the swollen and therefore broader pod. We have seen, however, that in Alaska the pod of *A. aboriginum* is sometimes decidedly tumid and sometimes (but only

when greatly flattened) reaches a diameter of 7–9 mm. Probably *A. Cottoni* does not deserve the rank of species.

Both on Hurricane Ridge and on Mt. Angeles *A. Cottoni* is associated with a local form of *Oxytropis viscida* Nutt., a species almost as perplexingly polymorphic as *A. aboriginum* and resembling it in its wide but interrupted range and in its kinship with a Eurasian complex. The dispersal patterns of *A. aboriginum* and *O. viscida* in America are strikingly similar, especially at their western and southeastern limits. Both are commonest in the Rocky Mountains and become exceptionally polymorphic in Alaska and Yukon. Both reach the Wallowa Mountains in Oregon, the East Humboldts in Nevada, and the Wasatch in Utah, and both are represented on a slaty talus in Gaspé County, Quebec, by a slightly aberrant, widely disjunct population which has been described as an independent species (*A. scrupulicola; O. gaspensis* Fern. & Kels.). The viscid *Oxytropis* of the Olympics is not quite identical with any other known population of *O. viscida* (cf. Barneby, 1952, map 7); prolonged isolation has presumably enabled a peculiar type to become dominant in this one locality. Similarly *A. Cottoni* may represent the progeny, only slightly modified, of an *A. aboriginum* which reached the Olympic Peninsula in company with the *Oxytropis* during a cool glacial period. The taxonomic status of forms which are greatly isolated spatially but not greatly altered morphologically is generally open to dispute, and the case of *A. Cottoni* is no exception. Its disposition is contingent, however, not only on theoretical standards of comparison but also on stabilization of the taxonomy and nomenclature of the whole circumboreal complex covered by the names *A. aboriginum* and *A. australis.*

VI. Sectio HEMIPHACA

Caulescent perennials, with taproot and superficial or shallowly buried root-crown; *vesture* basifixed, often scanty; *stipules* dimorphic, the large lower ones adnate to the suppressed petiole, fully amplexicaul, either free or shortly connate, forming a loose, papery, obtusely 2-lobed sheath broader than the stem, the upper ones narrower, free; *leaves* imparipinnate, with ± 5–15 leaflets; *flowers* racemose, nodding at full anthesis, of moderate size, the banner 10–14.5 cm. long; *pedicels* little thickened but persistent; *calyx-tube* campanulate, sometimes deeply so; *petals* whitish, regularly graduated, the banner recurved through ± 40°, the wings emarginate or bidentate at apex, the *keel-tip* obtuse; *pod* erect, sessile, deciduous from an incipient gynophore, obliquely ovoid, tumid but not bladdery, keeled ventrally, grooved dorsally, bilocular in the proximal ½–⅔, the valves papery-membranous; *dehiscence* apical and downward through both sutures and the septum, the valves completely separating; ovules 6–10.—A section of uncertain limits and therefore unknown numbers, principally of montainous central Asia, 1 on the upper Yukon River in Yukon and Alaska, ours cold-climate xerophytes.

Astragalus sect. Hemiphaca K. & K. in Bull. Soc. Nat. Mosc. 25: 329. 1842.—Sp. typica: *A. Hemiphaca* K. & K.—*Astragalus* subgen. *Phaca* sect. *Hemiphaca* (K. & K.) Bge., Astrag. Geront. 1: 20. 1868, pro parte, exclus. spp. plur.

Atelophragma sect. *Williamsiana* Rydb. in Bull. Torr. Club 55: 132. 1928.—Sp. typica: *A. Williamsii* (Rydb.) Rydb. = *Astragalus Williamsii* Rydb.

The foregoing description of sect. *Hemiphaca* is designed to accommodate only the American *A. Williamsii* and the sectional typus *A. Hemiphaca.* The majority of the Asiatic species referred to the greatly enlarged and too loosely defined sect. *Hemiphaca* sensu Bunge (l.c.) or to the more precisely elaborated subsect. *Euhemiphaca* Gontscharov & Borissova (1946, p. 73) are known to me only by description; and an accurate or informed delimitation of the group lies beyond the scope of this account. From the provincial point of view sect. *Hemiphaca* is distinguished from the related *Oroboidei* and *Hemiphragmium* by the erect, sessile pod which disjoints from the receptacle when ripe instead of dehiscing on the raceme. In other respects it agrees with *Hemiphragmium,* of which it has the stipules and bidentate or at least deeply emarginate wings. The Williams milk-vetch is taxonomically isolated in our flora, although its affinities to the sections mentioned are obvious and were appreciated by Rydberg when he assigned it to a monotypic section in *Atelophragma.*

10. Astragalus Williamsii

Commonly rather tall, sparsely and sometimes only minutely strigulose with filiform or somewhat flattened and scalelike, appressed or subappressed hairs up

to 0.2–0.65 mm. long, the herbage green or perhaps somewhat glaucescent when fresh, of thick texture, the leaflets glabrous above and often almost so beneath, the stems sometimes more densely pubescent at base than distally; *stems* several, erect and ascending in clumps from the knotty root-crown, 1.8–3.5 (5) dm. long, simple, at base leafless, purplish, becoming stramineous and striate upward, floriferous from 1–4 nodes beyond the middle, the inflorescences projected well beyond the leafy part of the plant; *stipules* 3–9 mm. long, dimorphic, the lowest oblong-obovate, several-nerved, united to the suppressed petiole, fully amplexicaul, either free or shortly connate, the median and upper ones narrower, less strongly amplexicaul, the uppermost lanceolate or narrowly triangular, membranous or thinly herbaceous distally, the blades often deflexed, all glabrous dorsally but commonly thinly ciliate and beset with a few marginal processes; *leaves* 2.5–8.5 (10) cm. long, the lowest shortly petioled, the rest subsessile, with (3) 5–15 firmly petiolulate, linear-oblong, narrowly oblanceolate or lanceolate, more rarely oblong-obovate or even broadly obovate, retuse or sometimes obtuse, flat or loosely folded, dorsally keeled leaflets 6–34 (40) mm. long, the terminal one often a little longer than the last pair; *peduncles* stiffly erect, (3) 4–16 (20) cm. long, the earliest and stoutest greatly surpassing the leaf; *racemes* at first anthesis compactly 12–30 (35)-flowered, the flowers at first ascending, then nodding, the axis early elongating, 3–11.5 (14) cm. long in fruit; *bracts* membranous, pallid, triangular-lanceolate, lance-acuminate, or linear-caudate, (1.5) 2.5–9 mm. long; *pedicels* straight and ascending or a little arched outward, at anthesis 1–2.4 mm., in fruit a trifle thickened and 1.4–3.5 mm. long, subpersistent; *bracteoles* 0; *calyx* 4.3–6.7 mm. long, densely but shortly strigulose with black mixed with a few (rarely many) white hairs, the slightly oblique disc (0.6) 0.9–1.2 mm. deep, the tube 3.4–4.8 mm. long, 2.8–3.5 mm. in diameter, the broadly subulate or triangular-subulate teeth 0.9–2.8 mm. long, the ventral pair broadest but either longest or shortest, the ventral sinus very broad, the orifice oblique, the whole becoming papery, ruptured, marcescent; *petals* whitish or ochroleucous, often drying yellowish, the keel-tip maculate; *banner* obovate- or ovate-cuneate, -oblanceolate, or spatulate, deeply notched or subentire, (10) 11–14.6 mm. long, (5.4) 6–7.4 mm. wide; *wings* (8.1) 9.3–11.5 mm. long, the claws 3.3–4.5 mm., the oblong-oblanceolate, obliquely bidentate or emarginate, nearly straight blades (5.9) 6.8–8.6 mm. long, 2–3.3 mm. wide; *keel* (7) 7.7–9.1 mm. long, the claws (3.2) 3.6–4.5 mm., the half-obovate blades (4.4) 5.2–6.2 mm. long, 2.4–3 mm. wide, abruptly incurved through 85–95° to the rounded apex; *anthers* 0.4–0.6 mm. long; *pod* erect, sessile but elevated on an incipient gynophore 0.4–0.6 mm. long, the body obliquely ovoid or lance-ovoid, somewhat inflated but not bladdery, (7.5) 8.5–16 mm. long, 3.5–6.5 mm. in diameter, rounded at base, contracted at apex into a shortly conical, erect or commonly slightly declined beak, carinate ventrally by the rather prominent but filiform suture, deeply and openly sulcate dorsally, the thin, green, minutely black- and white-strigulose valves becoming brownish-stramineous, papery-membranous, delicately reticulate, inflexed in the lower ½–⅔ as a complete, hyaline, lenslike septum 1.2–2.3 mm. wide; *ovules* 6–8 (10); *seeds* purplish-green or -brown, smooth but dull, 2.6–3.1 mm. long.—Collections: 18 (o); representative: *Porsild & Breitung 9668* (NY, UC); *Tarleton 92a, 92b* (NY); *Eastwood 595* (CAS); *Cody & Webster 4986, 5956* (DAO, NY), *5959* (DAO); *Calder & Gillett 25,009, 25,838* (DAO).

Turfy creek banks and about aspens, in open woodlands and on sandy or gravelly river bluffs, locally plentiful along the upper Yukon and its tributaries in Yukon and eastcentral Alaska.—Map No. 5.—June and July.

ASTRAGALUS WILLIAMSII (Robert Statham Williams, 1859–1945, distinguished bryologist) Rydb. in Bull. N. Y. Bot. Gard. 2: 175. 1901.—"The type was collected by R. S. Williams near Big Salmon, Yukon, August 22, 1899."—Holotypus (2 sheets), NY! isotypus, US!—*Atelophragma Williamsii* (Rydb.) Rydb. in Bull. Torr. Club 55: 132. 1928.

Astragalus Gormani (Martin Woodlock Gorman, 1853–1927, gifted amateur botanist, active chiefly in Oregon) Wight ex Jones, Rev. Astrag. 132, Pl. 26. 1923.—"In moist ground on creek banks near Fort Selkirk . . . Gorman."—Holotypus, collected near Fort Selkirk on July 8, 1899, US! isotypi, ND, NY, ORE!

The Williams milk-vetch is an interesting and rather handsome species, resembling some of the coarser and greener forms of *A. aboriginum* in its stipules, mostly sessile leaves composed of about three to seven pairs of leaflets, and emarginate or bidentate wing-petals, but easily distinguished by the erect, sessile pod of papery-membranous texture which disjoints when ripe and separates into two halves. Some variation is found in the size of the flowers and the length of the calyx-teeth, which tend to be crowded toward the dorsal side of the calyx and away from the broad, deeply cut-back ventral sinus. The pod varies from shortly and plumply ovoid to lance-ovoid, but despite the variation in length the ovules remain almost constantly either three or four, exceptionally five pairs. The plants of Yukon Territory are very thinly pubescent, the stems and leaves appearing almost glabrous to the naked eye, but populations around Big Delta in the Tanana Valley, Alaska, are decidedly strigulose throughout except for the upper leaf-surface. According to Porsild (in Nat. Mus. Canad. Bull. 121: 239) the stems are slightly glutinous when fresh and the foliage somewhat fleshy. The fresh petals have been described by collectors as white, cream-colored, or yellow; they appear ochroleucous in dried specimens, but the bluish-purple keel-tip remains conspicuous.

PHALANX B

The HOMALOBOID ASTRAGALI

VII. Sectio STRIGULOSI

Caulescent perennials, tall and robust or dwarf and slender, with a taproot and superficial or shallowly buried root-crown or caudex (in 2 sp. ramifying underground and subrhizomatous); *vesture* basifixed; *stipules* all, or at least the lowest ones, fully amplexicaul and connate, the upper ones often free, the lowest sometimes ruptured in age; *leaves* imparipinnate, the leaflets mostly thin-textured, 9–41; *flowers* racemose, more rarely subumbellate, few to very numerous, horizontal or commonly nodding at full anthesis, of moderate or small size, the banner 4.5–14.5 mm. long; *pedicels* in fruit a little thickened, persistent or tardily disjointing with the marcescent calyx; *calyx-tube* campanulate; *petals* ochroleucous or purple, regularly or irregularly graduated, the wings often as long, sometimes longer than the banner, the keel 3.5–10.2 mm. long; *pod* pendulous or deflexed, stipitate or sessile, nearly always persistent on the receptacle, broadly to narrowly oblong-elliptic or linear-oblong in profile, straight, decurved, or more rarely incurved, the body dorsiventrally or subtrigonously compressed, subbi-, semibi-, or unilocular, the septum only rarely completely obsolete, the valves papery; *dehiscence* either primarily apical and downward through either suture, or basal, through the stipe and dorsal suture (unknown in many spp.); *ovules* 4–24.—Spp. 24, most numerous and diverse in summer rainfall areas of temperate Mexico, 5 in southwestern United States, 1 extending southeast to Guatemala and Honduras, mostly of dry or summer-moist pine and oak forest, 1 *(A. radicans)* an obligate mesophyte.

ASTRAGALUS sect. STRIGULOSI Jones, Rev. Astrag. 184. 1923.—Sp. typica: *A. strigulosus* sensu Jones (non Kunth) = *A. longissimus* (Jones) Barneby.—*Atelophragma* sect. *Strigulosa* Rydb. in Bull. Torr. Club 55: 119 (in clave), 155, sequ. 1928.

Astragalus sect. *Strigulosi* subsect. *Recurvi* Jones, Rev. Astrag. 184 (in clave). 1923.—Sp. typica: *A. recurvus* Greene.

Atelophragma sect. *Seatoniana* Rydb. in Bull. Torr. Club 55: 119 (in clave), 163. 1928.—Sp. typica: *A. Seatoni* (Jones) Rydb. = *A. micranthus* var. *Seatoni* (Jones) Barneby.

Three-fourths of the numerically important sect. *Strigulosi* are endemic to temperate Mexico and form the largest group of *Astragalus* native to that country. One Mexican species extends southeast along the Cordillera into Honduras, and five are endemic to Arizona and New Mexico. The true home of *A. microcymbus,* described from the Gunnison Valley in Colorado, is not known for certain. The majority of Mexican *Strigulosi* are greatly restricted in range, several being known only from the type-locality, or from one or two stations close together. Much remains to be learned about their life history, morphology, and interrelationships, and the following treatment is little more than a preliminary sketch.

The section was formulated by Jones around a core of *A. guatemalensis, A. radicans (reptans), A. tolucanus, A. Rosei* (=our *micranthus*), *A. cobrensis,* and *A. strigulosus* (sensu Jones, non Kunth). The last-named was a mixture of our *A. longissimus* and elements of related species, but we need not hesitate to take up the epithet *Strigulosi* if we select *A. longissimus,* rather than *A. strigulosus* Kunth, as lectotypus of the section. Of the species originally referred here by Jones, the piptoloboid *A. platytropis* and the free-stipulate *A. Brandegei* and *straturensis* have been removed to other groups. The *Strigulosi* were transferred by Rydberg (1928, l.c.; 1929, p. 375) to *Atelophragma* and greatly elaborated. Rydberg's circumscription of the group is here modified only to the extent that the small-flowered *Atelophragma* sect. *Seatoniana* is treated as an inseparable element of a natural whole. It should be mentioned that several *Strigulosi* with slightly incurved, rather than the much commoner decurved or straight pod were placed by Jones in his sect. *Micranthi,* where their connate stipules and almost always persistent pod mark them as foreign.

Morphological features common to the *Strigulosi,* disregarding the exceptions noted in the synopsis below, are the connate stipules, nodding flowers of small or at best moderate size, and deflexed or pendulous, emmenoloboid, dorsiventrally or trigonously compressed, partly or fully bilocular pods of papery texture. The pod is most often stipitate; but in what appear to be the more advanced forms, the stipe is gradually shortened until in one or two species the fruit becomes truly sessile. In the very small-flowered *A. Purpusi,* the proportionately tiny pod is not only sessile but apparently disjoints from the receptacle when fully ripe; and in *A. pueblae* and *microcymbus,* which have equally small flowers and pods, the septum is rudimentary or obsolete. The dehiscence of the pod is remarkably variable in the section, in the first instance either apical or basal, thence extending along either one or along both sutures. Unfortunately the method of opening is known in only half the Mexican *Strigulosi,* so that its taxonomic value above the level of species, if any, remains to be evaluated. As a general rule the pod of the *Strigulosi* tends to arch downward or, when straight, to have the prominent ventral suture slightly more convex as seen in profile than the dorsal one; but a lunate inward curvature is characteristic of *A. regiomontanus, A. esperanzae,* and some forms of *A. micranthus.*

The gamut of variation in the section is so great that we are led to seek more exactly definable subsidiary categories within it, equivalent if possible to the subsections recognized elsewhere in the Atlas. The species fall readily into groups which are doubtless natural, but these cannot yet be defined in anything like mutually exclusive terms. Study of this problem is properly deferred until we are better informed on such critical points as the fall and dehiscence of the fruit in all members of the section. For the present the architecture of the section, so far as it is understood, may be expressed synoptically:

Group I. Flowers of moderate size, with banner (mostly 9–14 mm. long, only 7–9 mm. long in *A. hidalgensis, A. potosinus, A. zacatecanus,* and *A. pennellianus*) gently recurved through ± 45°, and mutually symmetric wings little or scarcely incurved; *calyx* mostly 5.5–9 mm. (in *A. hidalgensis* only 3.4–4.5 mm.) long; *pod* usually stipitate (sessile or subsessile in *A. radicans, A. Lyonetii, A. hidalgensis*), the body dorsiventrally (in *A. altus* more laterally) compressed, semibilocular; *ovules* mostly 8–24 (sometimes fewer in *A. tolucanus* and *A. altus*). Includes in addition to those mentioned: *A. guatemalensis, A. legionensis, A. Hintoni, A. strigulosus, A. jaliscensis, A. regiomontanus,* and *A. tioides.*

Group II. Flowers formed as the preceding, but very small, the calyx ± 2–3 mm., banner ± 4.5–7.5 mm., keel 3.5–4.5 mm. long; *ovules* 4–8; *racemes* dense. Includes *A. Purpusi* and *A. pueblae.*

Group III. Flowers as in Group I, but the petals all more strongly incurved, variable in length, the calyx 2.5–6 mm., the banner 4.5–9.5 mm. long; *wings* mutually symmetrical; *pod* essentially sessile, often incurved; *ovules* 6–18; *racemes* dense. Includes *A. micranthus* and *A. esperanzae.*

Group IV. Flowers small, loosely or remotely racemose, the banner recurved through ± 90°, 5.5–8 mm. long, the wings mutually asymmetric (the left one more strongly incurved than the right), the keel 4.5–6.5 mm. long; *calyx* 4.5–6.5 mm. long; *pod* stipitate, sometimes shortly so, narrow and elongate, straight or decurved, subtrigonous, semi- or subbilocular; *ovules* 7–20. Includes *A. Rusbyi, A. longissimus, A. Egglestonii, A. recurvus.*

Group V. Flowers as in Group IV; *pod* sessile or nearly so, much shorter and broader, dorsiventrally compressed as in Group I, subbi- or unilocular; *calyx* 2.2–3.5 mm., banner ± 5.5–7.5 mm., keel ± 3.5–6 mm. long; *ovules* 4–10. Includes *A. cobrensis* and *A. microcymbus.*

There is much overlapping in the differential characters of the groups, which are perhaps not drawn along phylogenetically natural lines. The following key to the species is artificial.

The affinities of sect. *Strigulosi* within the genus are far from clear, remaining open to controversial interpretations. In assigning the group to *Atelophragma* Rydberg assumed a relationship to our *Oroboidei* and *A. alpinus,* from which they cannot be separated by any substantial difference in the exterior morphology, although their physiological adaptation to a subtropical rather than an arctomontane environment argues a long separate history. If the *Strigulosi* are indeed closely akin to the *Oroboidei,* they should prove to belong to the circumboreal series with chromosomes in multiples of eight; but as yet we have no count in the section. It seems equally probable, as Jones suggested by placing them side by side in his Revision, that sect. *Strigulosi* and sect. *Scytocarpi,* so similar in growth-habit, stipule, and flower, represent parallel branches issuing from a common, basically homaloboid and therefore American stock. If such is the case the *Strigulosi,* in nearly all of which some rudiment at least of septum survives in the pod, should be the more primitive group, even though it possesses its own highly specialized forms; and the chromosomes should prove also to be in the n = 11 or 12 series. The affinities of the monotypic *Tiopsoidei* and *Scalares,* near relatives of the *Strigulosi,* are mentioned in following pages.

Key to the Species of Sect. Strigulosi

1. Racemes 5–many-flowered, the more vigorous racemes of any given plant over 5-flowered (2)
   2. Pod (either glabrous or strigulose) at once exactly sessile and incurved, linear-lanceolate to slenderly ovate-acuminate in profile, 12–18 mm. long, 3–4 mm. in diameter; *banner* ± 7.5–9.5 mm. long; *keel* 6–7.5 mm. long; San Luis Potosí to Puebla ..... 33. *A. esperanzae*
   2. Pod either stipitate, or sessile, but if sessile then either broader (and the petals then longer), or shorter (the petals then shorter), and if incurved then not over 13 mm. long, and if as long (combined with flowers of the size given) then strongly decurved; within the same range the flowers either much larger or much smaller when the pod is sessile (3)
      3. Ovary and pod pubescent (4)
         4. Petals relatively long, the banner 9–14.5 mm., the keel 6.4–10.2 mm. long, shorter than the banner (5)
            5. Plants prostrate, the stems mostly over 3 and up to 8 dm. long (or longer), rooting adventitiously at the flowering nodes; *leaves* subtending the peduncles vertical to the ground, all petioled; *flowers* relatively large, the calyx-tube 4.3–5.1 mm., the banner 12–14.5 mm. long; *petals* ochroleucous; *pod* subsessile, ± 1.5–2 cm. long, 20–31-ovulate; *plants* mesophytes, of low meadows in the Valley of Mexico ..... 17. *A. radicans*
            5. Plants variable in habit, the stems erect, diffuse, or prostrate and trailing, but never rooting at the nodes; *leaves,* except the lowest, subsessile; *flowers* mostly smaller, or purplish, but if both ochroleucous and with banner up to 12.5 mm. long (as in *A. Lyonnetii,* with similarly formed but 15–18-ovulate pods), then the stems slender, not over 3 dm. long; *xerophytes* or *plants* of moist woodland (6)
               6. Racemes 20–45-flowered; *petals* yellowish; *pod* more strongly compressed laterally than dorsiventrally, narrowly sulcate dorsally; White and Sacramento Mountains, New Mexico ..... 24. *A. altus*
               6. Racemes mostly less than 20-flowered, if more than 20-flowered then the petals purplish; *pod* more strongly compressed dorsiventrally than laterally, widely and openly sulcate dorsally; Hidalgo to Oaxaca (7)
                  7. Petals ochroleucous, drying straw-yellow; *stems* slender, 0.5–3 dm. long; local in the mountains bordering the Valley of Mexico ..... 16. *A. Lyonnetii*

7. Petals ordinarily purple, always so if the stems less than 3 dm. long or in the range of the last (8)
8. Calyx 6.5–9.2 mm. long, the elongate teeth 3–4.7 mm. long; *bracts* usually broad and conspicuous, (0.8) 1–2 mm. wide; *herbage* strigulose; local in Mexico State and adjoining Michoacán (if led hither by plants with very short stems arising from slenderly branching subterranean caudex, cf. *A. Hintoni*) ..... 14. *A. tolucanus*
8. Calyx mostly shorter, the teeth not over 2.5 mm. long if the vesture appressed, if up to 3 mm. long, then the herbage loosely pilosulous; *bracts* narrower ..... 11. *A. guatemalensis*

4. Petals shorter, the banner 4.5–8.4 mm. long; *keel* 3.5–6 mm. long (up to 6.5 mm. in *A. recurvus* of centr. Arizona), or if up to 7 mm. long then equaling the banner (9)
9. Pod stipitate, the stipe sometimes concealed by the marcescent calyx but at least 2 mm. long, the body elongate, straight or nearly so, 13–25 mm. long (10)
10. Racemes very loosely (10) 15–40-flowered, the axis 6–20 cm. long in fruit; *banner* abruptly bent through ± 90°; *pod* trigonous, not strongly compressed dorsiventrally; Arizona and Chihuahua (11)
11. Leaflets (11) 17–25; *herbage* green, thinly strigulose; *pod* 3–4 mm. in diameter; centr. Arizona ..... 29. *A. Rusbyi*
11. Leaflets 25–39 (45); *herbage* usually silky-hirsutulous; *pod* ± 4–5 mm. in diameter; Chihuahua ..... 30. *A. longissimus*
10. Racemes loosely but more shortly 10–20-flowered, the axis (1.5) 2.5–7 cm. long in fruit; *banner* gently recurved through ± 45°; *pod* dorsiventrally compressed, openly sulcate dorsally, San Luis Potosí and Guanajuato to Durango ..... 18. *A. potosinus*
9. Pod sessile or subsessile, the stipe either obsolete or less than 1 mm. long and no longer than the calycine disc, the body commonly 5–11 mm. long, to 13–25 mm. long in *A. recurvus* of centr. Arizona but then strongly curved downward (12)
12. Racemes densely 30–many-flowered, oblong-cylindric at full anthesis, both flowers and fruits retrorsely imbricated; *leaflets* 19–27 (31); s.-centr. Mexico ..... 32. *A. micranthus*
12. Racemes fewer-flowered, looser, if over 25-flowered (as in some plants of *A. cobrensis* of Arizona and New Mexico) then the leaflets only 11–23 (13)
13. Pod elongate, linear-oblong or -elliptic in profile, 13–25 mm. long, 2.3–3 mm. in diameter, strongly decurved, compressed-triquetrous, narrowly grooved dorsally; centr. Arizona ..... 28. *A. recurvus*
13. Pod either shorter, or of plumper outline, or both, 5–15 mm. long, (2.2) 2.5–7 mm. in diameter, slightly if at all decurved; e.-centr. Arizona to Colorado and Puebla (14)
14. Stems 6–25 cm. long; *leaflets* mostly 11–23; *pod* partially or fully bilocular, the septum at least 0.4 mm. wide; Arizona and New Mexico to Mexico (15)
15. Racemes dense, the axis 1–3 cm. long in fruit; *calyx-tube* 1.5–2.2 mm. long; *keel* 3.5–4.6 mm. long; *pod* 5–8 mm. long, 2–3.2 mm. in diameter, 5–7-ovulate; Coahuila to Puebla (16)
16. Pod fully bilocular, the septum 1.5–2.3 mm. wide; Coahuila and Nuevo León ..... 26. *A. Purpusi*
16. Pod semibilocular, the septum 0.4–0.6 mm. wide; Mt. Orizaba and vicinity, Puebla; var. *Seatoni* of ..... 32. *A. micranthus*
15. Racemes loose, the axis 2–7.5 cm. long in fruit; *calyx-tube* 2.2–2.7 mm. long; *keel* 4.4–6 mm. long; *pod* (7) 9–15 mm. long, 3.5–7 mm. in diameter, 10–13-ovulate; Arizona and New Mexico ..... 34. *A. cobrensis*
14. Stems 3.5–6 dm. long; *leaflets* 11–15; *pod* unilocular, the septum obsolete or rudimentary, not over 0.1 mm. wide; species very local in Colorado and Puebla (17)
17. Peduncles solitary in the axils; *racemes* subumbellate, the axis 5–10 mm. long in fruit; Puebla ..... 27. *A. pueblae*

17. Peduncles paired in the upper axils, paired with a branchlet in some lower axils; *racemes* loose, the axis (1) 2–4 cm. long in fruit; Gunnison County, Colorado, perhaps adventive and to be sought elsewhere ..... 35. *A. microcymbus*

3. Ovary and pod glabrous (18)

18. Flowers small, the banner 5.8–8 mm., the keel ± 4.2–5.6 mm. long (19)

19. Banner abruptly recurved through 90°; *wings* asymmetric, the left one more strongly and abruptly incurved than the right; *leaflets* 21–29; *body* of the pod linear-oblong or -oblanceolate in profile, 1.5–3 cm. long, (2.5) 3–4 mm. in diameter; w.-centr. New Mexico and adjoining Arizona ..... 31. *A. Egglestonii*

19. Banner gently recurved through ± 45°; *wings* equally and only slightly incurved; *pod* 1.3–2.3 cm. long, obovate or oblong-elliptic in profile, 4.5–5.5 mm. in diameter ..... 25. *A. hidalgensis*

18. Flowers larger, the banner 8–15.5 mm., the keel 6.1–10.2 mm. long (20)

20. Racemes 30–50-flowered, 10–18 cm. long in fruit; *leaflets* 9–17; *pod* elongate, ± 2 cm. long, 5.5 mm. in diameter, 20–24-ovulate; Zacatecas ..... 19. *A. zacatecanus*

20. Racemes 5–30-flowered, sometimes up to 40-flowered in allopatric *A. strigulosus,* 1–10 cm. long in fruit; *leaflets* usually more numerous, but if not so then the ovules fewer (21)

21. Body of the pod elongate, 1.6–3.5 cm. long, 4–7 mm. in diameter, ± 4–5 times longer than wide; local species of Nuevo León, Jalisco, and Durango (22)

22. Raceme-axis 5–10 cm. long in fruit; *ovules* 22–24; Jalisco. Vesture thin, appressed; *stems* 2–3.5 dm. long; *leaflets* 19–29, 3–12 mm. long; *peduncles* 8–16 cm. long, greatly surpassing the leaf; *stipe* of the pod 3–4 mm. long, the body straight ..... 20. *A. jaliscensis*

22. Raceme-axis 2–4 cm. long in fruit; *ovules* 10–14; either Nuevo León or Durango (23)

23. Vesture thin, subappressed; *leaflets* mostly 15–23, 5–18 mm. long; *stems* over 5 dm. long; *peduncles* 2–5 cm. long; *stipe* of the pod 1.5–2 mm. long, the body lunately incurved; Sierra Madre Oriental in Nuevo León ..... 21. *A. regiomontanus*

23. Vesture comparatively dense, subvillosulous; *leaflets* mostly 25–41, 1–5 mm. long; *stems* 1–4 dm. long; *peduncles* 4.5–9 cm. long; *stipe* of the pod 3.5–7 mm. long, the body straight or a little decurved; Sierra Madre Occidental in Durango ..... 22. *A. Pennellianus*

21. Body of the pod shorter, or if no shorter then relatively broader, 12–20 mm. long, 4–8 mm. in diameter; w. Jalisco e. to Hidalgo, s. and e. to Honduras (24)

24. Calyx 6.4–9.2 mm. long, its tube 3.2–4.5 mm., its teeth 3–4.7 mm. long, the whole strigulose with appressed hairs; *flowers* purple, the prominently striate banner 10.5–15.5 mm. long; if the *stems* over 1.5 dm. long then the bracts usually broad and conspicuous, (0.8) 1–2 mm. wide; local in Mexico and adjacent Vera Cruz (25)

25. Racemes 15–30-flowered; *stems* several or many arising together from the root-crown, 1–5 dm. long; Mexico (Estado and Distr. Fed.) ..... 14. *A. tolucanus*

25. Racemes 5–10-flowered; *stems* arising singly and few together from slender rhizome-like caudex-branches; Cofre de Perote, Vera Cruz; var. *cofrensis* of ..... 13. *A. Hintoni*

24. Calyx either not over 6 mm. and its teeth not over 2.5 mm. long, or if as above (and then only from Isthmus of Tehuantepec e. to Honduras) either the teeth densely hispidulous-pilose or (in Mexico state and vicinity) the petals ochroleucous; *bracts* narrow (26)

26. Petals ochroleucous, immaculate; *calyx-teeth* (2.3) 3–4.3 mm. long; *pod* dehiscent dorsally at base only; erect plants of dry sunny slopes and mesas, Hidalgo s. to n. Oaxaca ..... 15. *A. strigulosus*

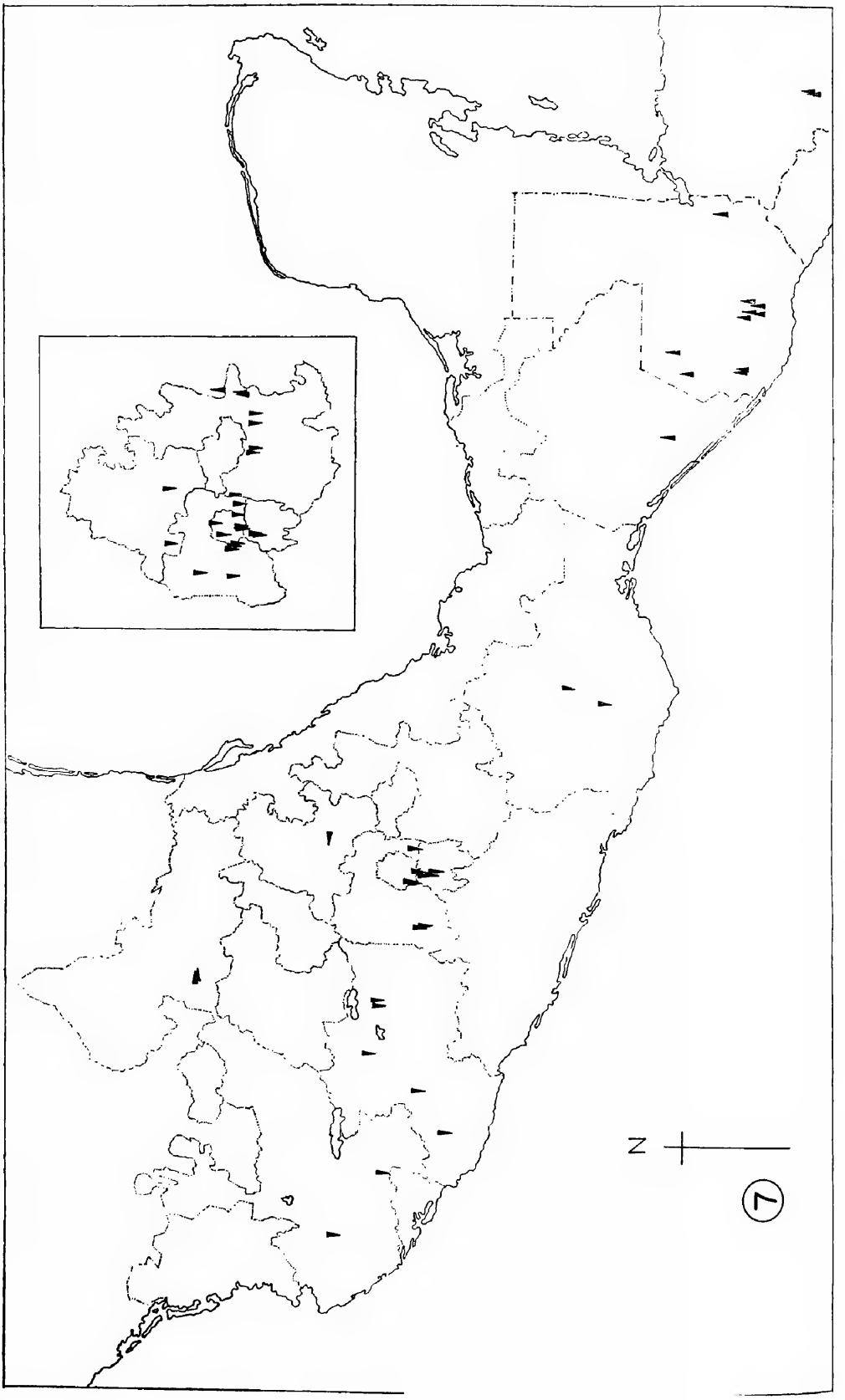
26. Petals pink-purple (fading ochroleucous in some old specimens, rarely so when fresh); *calyx-teeth* within the range of the pre-

ceding 0.6–2.5 mm. long; *pod* dehiscent its whole length and through the septum; diffuse or trailing plants, often vinelike, of pine-oak forests, mostly of cool or moist soils; s.-centr. Mexico to Honduras, sometimes above timber line in Guatemala ..... 11. *A. guatemalensis*

1. Racemes (1) 2–6-flowered; local species of Nuevo León, Michoacán, and San Luis Potosí (27)
   27. Plants low, the stems less than 1 dm. long; *pod-body* ellipsoid or oblong-ellipsoid, 1–1.5 cm. long, 3–4.5 mm. in diameter, 8–14-ovulate; Nuevo León or Michoacán (28)
      28. Plants silvery-canescent with rather long hairs up to 0.5–0.8 mm. long; *pod* glabrous; Nuevo León ..... 12. *A. legionensis*
      28. Plants greenish-cinereous, loosely strigulose with hairs up to 0.2–0.4 mm. long; *pod* pubescent; Michoacán; var. *Hintoni* of ..... 13. *A. Hintoni*
   27. Plants taller, the stems 3–5 dm. long; *pod-body* 2–3.2 cm. long, 5–6 mm. in diameter, 18–22-ovulate; San Luis Potosí ..... 23. *A. tioides*

11. Astragalus guatemalensis

Perennial, with a taproot and shallowly buried (perhaps sometimes superficial) root-crown, thinly strigulose or hirsutulous, the herbage green or sometimes cinereous in youth, the leaflets glabrous above, paler and variably hairy beneath; *stems* diffuse, decumbent, prostrate and trailing, or straggling up through supporting bushes, 0.7–15 (24) dm. long, sometimes flowering when simple and only 0.7–2 dm. long but more commonly freely branched upward and almost indefinitely elongating through a long flowering season; *stipules* submembranous, the lower ones becoming papery-scarious, 1.5–9 mm. long, usually dimorphic, the lowest of the main stems and of the branches (sometimes all) amplexicaul and connate through half their length or more into a bidentate sheath, the sheath sometimes ruptured in age, the upper ones mostly connate at base only, or semi-amplexicaul and free, with lanceolate to narrowly lance-acuminate or -caudate, erect or deflexed blades; *leaves* (1.5) 3–12 cm. long, subsessile or very shortly petioled, with (11) 17–37 opposite or scattered, oblong-elliptic, broadly oblanceolate, oval, ovate, or obovate, obtuse, truncate-emarginate, or retuse (sometimes also mucronulate), rarely elliptic and subacute, flat, thin-textured leaflets (2) 3–19 mm. long; *peduncles* slender, incurved-ascending, 3–15 (19) cm. long, nearly as long or longer than the leaf; *racemes* shortly 6–20 (30)-flowered, or those of some slender lateral branches only 2–5-flowered, the flowers early horizontal and declined in age, the axis little elongating, (0.5) 1–3.5 (5) cm. long in fruit; *bracts* submembranous, ovate-triangular, lanceolate, or linear-acuminate, often reflexed in age; *pedicels* at anthesis slender, ascending, 0.5–1.5 mm. long, early arched outward, in fruit thickened, persistent, 0.9–2.5 mm. long; *bracteoles* usually 0, rarely 2, minute; *calyx* variably pubescent with black, fuscous, more rarely white hairs, 3.2–7.8 mm. long, the somewhat oblique disc 0.7–1.1 mm. deep, the campanulate tube 2.6–4 mm. long, 2.2–3.5 mm. in diameter, the narrowly lance-subulate, subulate, triangular, or broadly deltoid teeth 0.6–4 mm. long; *petals* usually pinkish- or bluish-purple, rarely yellowish; *banner* recurved through 40–45°, rhombic-elliptic, obovate-spatulate, or ovate-cuneate, shallowly notched or emarginate, (8.5) 9–12 mm. long, 4.5–7 mm. wide; *wings* (8) 8.6–10.5 mm. long, the claws 3.2–4.6 mm., the narrowly oblong-oblanceolate, narrowly obovate, or linear-oblong, obtuse or emarginate, nearly straight blades 6.2–8 mm. long, 1.6–2.8 mm. wide; *keel* 6.8–8.3 mm. long, the claws (3) 3.5–4.6 mm., the half-obovate blades 3.6–4.6 mm. long, 2.1–2.7 mm. wide, abruptly incurved through 90–110° to the blunt-deltoid apex; *anthers* 0.4–0.55 mm. long; *pod* pendulous, stipitate, the stipe 1–5 mm. long, the body ellipsoid or oblong ellipsoid, tumescent or a trifle inflated, 12–21 mm. long, (4) 5–7 (8) mm. in diameter, straight or a trifle arched


N
7

downward, subtruncate to cuneate at both ends, cuspidate at apex, dorsiventrally compressed, obtusely carinate ventrally by the prominent suture, openly and shallowly sulcate dorsally, the thin, green, glabrous or strigulose valves becoming papery, stramineous or ultimately almost black, finely cross-reticulate, inflexed as a partial or nearly complete septum 0.5–1.5 mm. wide; *dehiscence* apical and downward through the length of the dorsal suture and the septum, the valves folding outward in age; *ovules* 10–18 (19); *seeds* chestnut- or mahogany-brown, smooth but scarcely lustrous, 1.7–2.5 mm. long.

Key to the Varieties of A. guatemalensis

1. Stems mostly over 3 dm. long (sometimes flowering at 1.5 dm., especially at great elevations, but almost indefinitely elongating over a long season of growth); *herbage* strigulose with short, appressed hairs; *stipe* of the pod 1–2.5 mm. long; Jalisco and Mexico s.-ward (2)
   2. Calyx 6.4–7.8 mm. long, the densely hispidulous teeth (2.8) 3–4 mm. long; Chiapas to Honduras ..... 11a. var. *guatemalensis*
   2. Calyx 3.2–6 mm. long, the strigulose teeth 0.6–2.5 mm. long; Oaxaca to Michoacán w. Jalisco, and Mexico ..... 11b. var. *brevidentatus*
1. Stems shorter, apparently not over 2 dm. long when in full fruit; *herbage* hirsutulous with spreading and ascending, straight or curly hairs; *stipe* of the pod 3.5–5 mm. long; apparently local, Sierra de Pachuca, Hidalgo ..... c. var. *Lozani*

11a. Astragalus guatemalensis var. guatemalensis

Stems up to 15 dm. long, sometimes flowering when only 1.5 dm. long; *leaflets* (17) 21–37; *racemes* densely and shortly 15–30-flowered, the flowers early declined and retrorsely imbricated, the axis 1.5–3 (3.5) cm. long in fruit; *calyx* densely pilosulous with black, fuscous, and sometimes a few white hairs, the tube 3.4–4 mm. long, (2.3) 2.6–3.5 mm. in diameter, the narrowly lance-subulate, rarely broadly triangular-subulate teeth (2.8) 3–4 mm. long; *petals* pinkish- or bluish-purple; *banner* (8.5) 9.5–12 mm. long; *stipe* of the pod 1–2 mm., the *body* (12) 14–20 mm. long, 5–6 mm. in diameter, glabrous; *ovules* 10–15.—Collections: 15 (o); representative: *Ghiesbreght 159* (GH, K); *Standley 61,481* (GH, MICH, NY); *Skutch 257, 726* (US); *Steyermark 50,941, 51,994* (NY); *Glassman* 2131 (NY).

Moist thickets, open banks in cloud forest, and brushy ravines, commonly in oak or pine forest, 5200–11,000, perhaps up to 12,400–13,050 feet, apparently not uncommon locally, Chiapas, Mexico, south through the cordillera of Guatemala to central Honduras.—Map No. 7.—August to February.

Astragalus guatemalensis (of Guatemala) Hemsl., Biol. Centr.-Amer., Bot. 1: 266. 1880, & Diagn. Pl. Nov. Mex. 41. 1880.—"... in monte ignivomo Fuego usque ad 10500 ped. alt., *Salvin & Godman*."—Holotypus, collected on the s.-e. ascent of Fuego in 1861, K! *Atelophragma guatemalense* (Hemsl.) Rydb. in Bull. Torr. Club 55: 159. 1928.

The Guatemala milk-vetch is a species of subtropical montane rain forest, found most frequently in Guatemala between 6500 and 11,000 feet but reported from as low as 5200 feet at its southern limit (lat. 87° 14′ N.) in Honduras. At these elevations the plants may begin to flower when only a few decimeters tall, but growth continues almost indefinitely through the fall and winter months and the stems may ultimately reach a length of 1.5 or 2.4 m., eventually becoming vinelike and straggling over the ground on open banks or reclining on bushes. Young specimens of an astragalus (*Shannon* distrib. *Donnell Smith 3676*, US, *3680*, K, US; *Beaman 2917, 3262*, NY) with stems only 5–14 cm. long at early anthesis and naked at base as though buried in volcanic ash, have been collected near the summit of Volcán de

Map No. 7. Southeastern Mexico and Guatemala. Range of *A. guatemalensis*: ◢ var. *guatemalensis*; ◤ var. *brevidentatus*; and ◖ var. *Lozani*; of ◗ *A. tioides*; and inset (top right), Mexico, Hidalgo and Puebla. Range of *A. micranthus*: ◤ var. *micranthus*; and ◢ var. *Seatoni*.

Agua at 12,400 feet elevation and on Volcán Acatenango above the 13,000 feet contour. The flowers are essentially as in var. *guatemalensis*; but until fruits can be obtained, it will be impossible to judge whether the plants represent a minor variant of *guatemalensis* dwarfed by exposure or altitude, or a distinct but certainly related species.

11b. Astragalus guatemalensis var. brevidentatus

Like var. *guatemalensis* in growth-habit, the stems 3–15 (24) dm. long; *leaflets* (13) 17–25; *racemes* shortly but more loosely 6–20 (30)-flowered, or those of terminal branchlets only 2–5-flowered. the axis (0.5) 1.5–3.5 (5) cm. long in fruit; *calyx* strigulose with black, rarely white hairs up to ± 0.2–0.3 mm. long, the tube 2.6–3.6 mm. long, 2.2–3 mm. in diameter, the triangular-subulate, broadly deltoid, or more elongate and then truly subulate teeth 0.6–2.5 mm. long; *petals* commonly pink-purple, rarely yellowish; *banner* 9–11.3 mm. long; *stipe* of the pod 1.5–2.5 mm., the *body* 12–21 mm. long, (4) 5–7 (8) mm. in diameter, glabrous or minutely black-strigulose; *ovules* (11) 12–18 (19).—Collections: 24 (iii); representative: *Hinton 12,917* (NY, TEX, US), *5232* (K, NY, US), *8912* (MICH, NY); *Matuda 18, 841* (MICH, NY); *Lyonnet 703* (NY, US); *McVaugh 13,457* (K, MICH), *14,382* (K, MICH); *Ripley & Barneby 13,405* (NY, RSA).

Brushy hillsides, open woodland, and shaded glens in mixed pine and oak forest, (5500) 6000–8500 feet, apparently not uncommon in the mountains of southcentral Mexico, from Mexico State to Michoacán and western Jalisco, south to Oaxaca.—Map No. 7.—May to January.

Astragalus guatemalensis var. brevidentatus (Hemsl.), comb. nov., based on *A. strigulosus* var. *brevidentatus* (short-toothed, of the calyx) Hemsl., Biol. Centr.-Amer., Bot. 1: 266. 1880.—"Mexico, (Barker). Cultivated specimens only in Hb. Kew."—Holotypus, cult. in hort. Kew. Aug. 13, 1838, K!

Phaca elongata (lengthy) Mart. & Gal. in Bull. Acad. Roy. Brux. 10²: 51. 1843 (non *A. elongatus* Willd., 1803).—"...sur les montagnes calcaires de Sola et sur les rochers gneissiques de Yolotepeque, dans la cordillère, au sud d'Oaxaca, de 7 à 8000 pieds."—Holotypus, not examined; isotypi, *Galeotti 3174,* from "montagnes près l'Océan Pacifique a 8000'," K, P (2 sheets)!

Astragalus guatemalensis var. *oaxacanus* (of Oaxaca) Jones, Rev. Astrag. 189, Pl. 43. 1923.—"This is Pringle's No. 6264 from Oaxaca."—Holotypus, collected in the Sierra de San Felipe, Oaxaca, December 10, 1895, US! isotypi, CAS, DAV, G, GH, K, ND, NY, P, PH!—*Atelophragma oaxacanum* (Jones) Rydb. in Bull. Torr. Club 55: 160. 1928. *Astragalus oaxacanus* Rose ex Jones, l.c., nom. nud.

Astragalus Painteri (Joseph Hannum Painter, 1879–1908, clerk at Smithsonian Institution, assisted J. N. Rose in Mexico) Rose ex Jones, Rev. Astrag. 190, Pl. 43. 1923.—"Sierra de Ajusco, Morales [i.e., Morelos], Mexico, May 26, 1898 ... Pringle's No. 6861 ..."—Holotypus, US! isotypi, GH, NY, POM!—*Atelophragma Painteri* (Rose) Rydb. in Bull. Torr. Club 55: 156. 1928.

The Oaxaca milk-vetch, var. *brevidentatus,* is the commonest and most widely dispersed in southcentral Mexico of the large-flowered *Strigulosi.* Similar to var. *guatemalensis* in the diffuse vinelike habit of growth and in nearly all technical characters other than the short-toothed, more thinly appressed-pubescent calyx, it is geographically separated from it by the dip in the main Cordillera corresponding with the Isthmus of Tehuantepec. The variety is so circumscribed in these pages as to include a number of minor variants; it could perhaps be divided profitably into two coordinate races corresponding with Jones's var. *oaxacanus* and *A. Painteri.* In the mountains lying between the valleys of Mexico and Cuernavaca the calyx-teeth are consistently very short, scarcely surpassing 1 mm. in length, and vary from broadly subulate to broadly deltoid, the typi of *A. Painteri* and var. *brevidentatus* being of the latter sort. To the west and south of this area the calyx-teeth become longer and narrower, varying from broadly subulate to exactly subulate, and from 1 mm. up to 2.5 mm. in length; however there seem to be no other differences correlated with the calyx-variants. The pod of the Oaxaca milk-vetch is most commonly glabrous, but a number of collections with minutely black-strigulose fruits are on record: several from Michoacán (*Frye & Frye 3105; Hinton 15,465,* both US; *Ripley & Barneby 13,425, 13,432,* both CAS, NY, RSA) one from Guerrero (*Hinton 14,899,* MICH, NY, UC); one from Oaxaca (the typus of var. *oaxacanus*); and the original

plant from which var. *brevidentatus* was described. These pubescent-ovaried plants are interpreted as individual variants of no taxonomic importance. The petals of var. *brevidentatus* are normally pinkish-purple, but they fade rapidly in the herbarium, often appearing ochroleucous after a few years; and ochroleucous or "pale yellow" flowers have been seen and reported in field notes (*Hinton 15,465*, US) as well as the commoner purple.

During the preliminary studies, before the identity of var. *brevidentatus* had been established, I annotated many sheets of this variety as var. *oaxacanus* Jones.

11c. Astragalus guatemalensis var. Lozani

Relatively dwarf, with a subterranean, slenderly forking caudex, the stems flowering and fruiting when 0.7–2 dm. long, the herbage hirsutulous; *leaflets* (11) 17–21 (25); *racemes* shortly 6–13-flowered, subumbellate at early anthesis, the axis 1–2 cm. long in fruit; *calyx* pubescent with short, dark, appressed and commonly some or many looser, pallid hairs, the tube 2.6–3.5 mm. long, 2.3–2.7 mm. in diameter, the lance-subulate teeth 1.4–3 mm. long; *stipe* of the pod 3.5–5 mm. long, the *body* 1.3–1.9 cm. long, 5–7 mm. in diameter, strigulose with pale or dark hairs; *ovules* 10–18.—Collections: 4 (o); representative: *Coulter 632* (K), *"631"* (GH); *Rose & Hay 5587* (NY, US).

Open pine woods, ± 9000 feet, known only from Sierra de Pachuca, Hidalgo. —Map No. 7.—June to September.

Astragalus guatemalensis var. Lozani (Filemon L. Lozano, assistant to C. G. Pringle) Jones, Rev. Astrag. 189, Pl. 43. 1929 (as to typus only).—"Sierra de Pachuca, Hidalgo, México, Pringle's No. 6935, July 28, 1898, 9000 ft. alt. . . ."—Holotypus, US! isotypi, BM, G, GH, K, NY, P, POM!—*Atelophragma Lozani* (Jones) Rydb. in Bull. Torr. Club 55: 161. 1928. *Astragalus Lozani* Rose ex Jones, l.c., in syn., nom. nud.

The Lozano milk-vetch should perhaps rank as a species distinct from *A. guatemalensis*, despite the similarity in form and size of the pods. It is distinguished from the two preceding varieties by stronger characters than either is from the other, and is readily identified by its comparatively short, slender stems which seem not to elongate during late summer and fall, by the hirsutulous vesture, and by the comparatively long stipe of the always strigulose pod.

The var. *Lozani* was collected first by Thomas Coulter *(No. 632)* at Real del Monte about 140 years ago and was quickly recognized by Bentham as a species undescribed at that time. A specimen of this collection, wrongly associated with a label properly belonging with Coulter's collection of *A. hidalgensis* from Zimapán *(No. 631)*, reached the Gray Herbarium under the manuscript name *A. leptopus* Bth. (mentioned by Gray in Pl. Wright. 2: 43) and was subsequently mistaken by Rydberg as an isotypus of *A. strigulosus* var. *gracilis* Hemsl. See further under *A. potosinus*.

12. Astragalus legionensis

Low or dwarf, shortly caulescent, with an initial taproot and slender, more or less widely creeping, rhizome-like caudex-branches (often giving rise to adventitious rootlets), hirsutulous nearly throughout with straight, spreading and loosely ascending, lustrous hairs up to 0.5–0.8 mm. long, the herbage greenish or silvery-canescent when young, the leaflets glabrous or nearly so above, the inflorescence black-hairy; *stems* of the year arising singly or few together from the caudex-branches, 2–5 cm. long, the internodes mostly concealed by loosely imbricated stipules, more rarely up to 12 mm. long; *stipules* scarious, pallid or stramineous, (1) 2.5–6 (9) mm. long, amplexicaul and connate through about half, or the lowest through nearly their whole length into a loose, bidentate sheath, sparsely pubescent, or the lowest glabrous dorsally; *leaves* (1.5) 2–5 (6.5) cm. long, slender-petioled, with (9) 17–27 usually crowded, oblong-elliptic, oblong, or oblong-obovate, emarginate, flat or loosely folded leaflets (1) 2–6.5 mm. long; *peduncles* slender, ascending, 1.5–5 cm. long, equaling or shorter than the leaf; *racemes* loosely but very shortly 2–5-flowered, the flowers declined in age, the axis scarcely elongating, 2-10 mm. long in fruit; *bracts* scarious, pallid, broadly lanceo-

late, 2–4 mm. long; *pedicels* at anthesis 1–2 mm., in fruit arched outward or recurved, 1.2–1.8 mm. long; *calyx* 6.5–7.9 mm. long, densely hirsutulous with black and often a few white hairs, the subsymmetric disc 0.5–1 mm. deep, the campanulate tube 3.2–3.5 mm. long, 2.4–2.9 mm. in diameter, the narrowly lance-subulate or linear teeth 2.9–4.4 mm. long, separated by obtuse sinuses, the whole becoming papery, marcescent unruptured; *petals* violet-purple; *banner* gently recurved through ±45°, obovate-cuneate or rhombic-obovate, shallowly notched, 9.6–14 mm. long, 5.6–6 mm. wide; *wings* 9.2–12 mm. long, the claws 3.6–4.2 mm., the narrowly obovate, oblanceolate, or linear-oblanceolate, obtuse or truncate, undulate-erose, gently incurved blades 6.5–8.8 mm. long, 1.9–3.5 mm. wide; *keel* 7.4–8.4 mm. long, the claws 3.7–4.5 mm., the half-obovate blades 4–4.4 mm. long, 2.2–2.5 mm. wide, abruptly incurved through 90° to the sharply or bluntly deltoid apex; *anthers* (0.45) 0.5–0.6 mm. long; *pod* pendulous, stipitate, the straight, slender stipe 2–2.5 mm. long, the body oblong-ellipsoid, 14–15 mm. long, 3–4.5 mm. in diameter, a trifle decurved, obcompressed, low-carinate ventrally by the suture, flattened or shallowly and openly grooved dorsally, the thin, green, glabrous valves becoming papery, stramineous, inflexed as a very narrow, incomplete septum ± 0.5 mm. wide; *ovules* 8–12; *dehiscence* and *seeds* unknown.—Collections: 3 (o); representative: *Pennell 17,130* (NY); *Mayer & Rogers 2986* (G, MO).

Open pine woods, 9000–10,350 feet, locally plentiful about the upper slopes and summits of Sierra del Infernillo and Cerro del Viejo, municipios of Galeana and Zaragoza, Sierra Madre Oriental, Nuevo León.—Map No. 8.—June to September.

ASTRAGALUS LEGIONENSIS (of León), sp. nov., leguminis forma affines *A. guatemalensem, A. tolucanum* et *A. Hintoni* simulans, a prioribus caulibus abbreviatis e caudicis subterranei repentis surculis solitariis paucisve simul emissis racemoque paucifloro toto abhorrens, ab ultimo habitu simillimo praesertim pube longa sericea, a var. *Hintoni* vera ovario glabro, ab *A. Hintoni* var. *cofrensi* racemo 2–5 (nec 5–10)-floro distincta.—Herbae diffusae humiles, caulium internodiis abbreviatis fere omnibus stipulis vaginantibus occultatis, foliolis 17–27, calyce 6.5–7.9 mm. longo, vexillo violaceo 9.6–14 mm. longo, legumine ± 1.5 cm. longo, 3–4.5 mm. lato, ovulis 8–12.—NUEVO LEON: ascent to Sierra Infernillo, 9–10,000 feet, Sierra Madre Occidental, June 16, 1934, *C. H. & M. T. Mueller 823*.—Holotypus, MICH! isotypi, GH, TEX, US!

A lowly but decorative species, forming, according to the collectors, dense mats of foliage in open pine forest, the Nuevo León milk-vetch superficially resembles the arctic *Oxytropis nigrescens* Fisch. in its lustrous vesture, loosely imbricated, sheathing stipules, and black-hairy inflorescence of few, relatively large, violet-purple flowers. The affinities of the species lie with *A. guatemalensis, A. tolucanus,* and *A. Hintoni,* in all of which the pod is similar in size and structure, but it is closest to the last, with which it shares the low stature and subterranean, sometimes adventitiously rooting caudex as well as the comparatively few-flowered racemes. The differential characters of *A. Hintoni* and its var. *cofrensis* are mentioned further under the next.

13. ASTRAGALUS HINTONI

Dwarf, diffuse, shortly caulescent perennial, with loosely forking and often adventitiously rooting subterranean caudex, loosely strigulose with subappressed and narrowly ascending, straight or somewhat incurved hairs up to 0.2–0.4 mm. long, the herbage subcinereous in youth, greenish in age, the leaflets bicolored, deeper green and glabrous above; *stems* above ground 1–10 (15) cm. long, simple or branched at the first 1–2 emersed nodes, the internodes all short, a few up to 1–1.4 cm. long but mostly shorter, sometimes all shorter than the stipules; *stipules* 1.2–7 mm. long, the lowest small, short and broad, connate into a loose, brownish or purplish, shortly bidentate sheath, the upper ones longer, pallidly membranous, connate through half their length or more; *leaves* (1) 1.5–6.5 cm.

long, shortly petioled or subsessile, with (11) 15–27 ovate-oval or oblong-elliptic, mostly retuse, sometimes truncate and mucronulate, flat, dorsally carinate leaflets (1) 2.5–7 mm. long; *peduncles* incurved-ascending, 0.5–5 cm. long, a little longer to much shorter than the leaf; *racemes* loosely but very shortly 3–14-flowered, the flowers loosely spreading or declined in age, the axis little elongating, 2-15 mm. long in fruit; *bracts* membranous or subherbaceous, ovate, elliptic, or lance-elliptic, 2–5.5 mm. long, 1–2 mm. wide; *pedicels* ascending or arched outward in age, at anthesis slender, 1–1.8 mm. long, in fruit a little thickened, 1.7–2 mm. long; *bracteoles* 0; *calyx* 6.4–8.4 mm. long, strigulose with white, fuscous, or fuscous and a few white hairs, the somewhat oblique disc 0.7–1 mm. deep, the campanulate, often purplish tube 3.4–4.2 mm. long, 2.8–3.5 mm. in diameter, the lance-subulate or subulate teeth 1.9–4.2 mm. long; *petals* "mauve-purple" or "purplish-blue", pallid or brownish when dried; *banner* recurved through about 40°, broadly rhombic-elliptic, truncate or emarginate, 11.3–15.6 mm. long, 5–8.6 mm. wide; *wings* 9.2–13.2 mm. long, the claws 4–5.4 mm., the oblong-elliptic, obtuse or obliquely truncate, nearly straight blades 6.4–9.5 mm. long, 2.5–3.1 mm. wide; *keel* 7.4–10.2 mm. long, the claws 3.9–5.8 mm., the half-obovate blades 4.1–5.4 mm. long, 2–3 mm. wide, incurved through 90–95° to the bluntly deltoid apex; *anthers* 0.4–0.5 mm. long; *pod* pendulous, stipitate, the stipe 2–3 mm. long, the body oblong-ellipsoid, 1–1.7 cm. long, 3.5–7.5 mm. in diameter, in form and compression closely resembling that of *A. legionensis*; *ovules* 10–16; *dehiscence* and *seeds* unknown.

ASTRAGALUS HINTONI (George B. Hinton, d. 1943, collected extensively in southcentr. Mexico), sp. nov., *A. legionensi* Barneby statura habituque praesimilis, sed pube strigulosa breviori, racemis 3–14- (nec 2–5)-floris, insuper apud var. *Hintoni* legumine pubescenti et apud var. *cofrensem* bracteis dentibus calycinis stipulisque abbreviatis facile distinguenda.—Herbae pumilae graciles, caulibus e caudice laxe ramoso subterraneo more *A. alpini* L. solitariis vel paucis simul emissis, racemisque paucifloris ab affinibus *Strigulosis* distinctissimae.—Typus sub var. *Hintoni* infra indicatur.

The Hinton milk-vetch is evidently a close relative of *A. legionensis* which it resembles in growth-habit and especially in the development of a slender, widely creeping, and sometimes adventitiously rooting, subterranean caudex. The whole species, of which two rather distinct forms are known, differs from *A. legionensis* in its shorter, less dense, and less lustrous vesture and in its somewhat more numerously flowered racemes, but each variety severally differs in considerably more details.

Key to the Varieties of A. Hintoni

1. Calyx-teeth 2.8–4.2 mm. long; *banner* 11.3–13 mm. long; *bracts* membranous, elliptic or lance-elliptic, 3–5.5 mm. long; *ovary* and pod strigulose; extreme e. Michoacán and adjoining Mexico ..... 13a. var. *Hintoni*
1. Calyx-teeth 1.9–2.6 mm. long; *banner* ± 14.5–15.5 mm. long; *bracts* subherbaceous, ovate, 1–2.5 mm. long; *ovary* and pod glabrous; Cofre de Perote, Vera Cruz ..... 13b. var. *cofrensis*

13a. ASTRAGALUS HINTONI var. HINTONI

Stems above ground up to 1–5 (8) cm. long; *stipules* 2–7 mm. long, strongly dimorphic, the lowest short and broad, connate into a loose, brown or purplish, shortly bidentate sheath, the upper ones longer, narrowly lanceolate to lance-acuminate, pallidly membranous; *peduncles* 1.5–5 cm. long; *racemes* 3–14 flowered; *calyx* 6.8–8.4 mm. long, strigulose with fuscous or partly white hairs, the tube (3.5) 3.8–4.5 mm., the teeth more than half as long; *keel* 7.4–9 mm. long, the claws 3.9–5 mm., the blades 4.1–4.8 mm. long.—Collections: 4 (o); representative: *Hinton 13,414* (K); *Barkley, Webster & Westlund 82* (TEX), *Beaman 4299* (NY).

In llano, or in moist black soil of the pine-bunchgrass zone, 12,500–12,600 feet, apparently local, known only from Cerros Pelón and San Andrés in extreme eastern Michoacán, and from the Nevado de Toluca (Volcán de Zinántecatl) in adjoining Mexico State.—Map No. 8—Late August to early October.

ASTRAGALUS HINTONI Barneby var. HINTONI, a var. *cofrensi* dentibus calycinis, bracteis (membranaceis pallidis) stipulisque elongatis, ovario glabro, petalisque subbrevioribus absimilis; ab *A. tolucano* etiam in elatis centrali-mexicanis montibus ignivomis obvia caulibus brevioribus e caudicis subterranei laxe ramosi ramulis hinc inde singulis vel paucis simul emissis racemisque paucifloris differt.—MICHOACAN: ascent of Cerro Pelón from Zitácuaro, distr. Zitácuaro, September 14, 1938, *George B. Hinton 13,240*.—Holotypus, NY! isotypi, MICH, P, UC, US (and presumably K, but not seen there).

A pretty astragalus, with the lowly creeping growth-habit of *A. alpinus* and few shortly racemose, purplish flowers, the Hinton milk-vetch is found at the same high elevations and probably in the same environment as *A. tolucanus*. The flowers of the two species are similar in form and the fruits almost identical, but *A. tolucanus* has many, considerably taller stems arising together from the crown of a taproot or from a very shortly forking, determinate caudex, and the racemes are about 15–30-flowered. The closest known relative of *A. Hintoni* (other than the variety following) is *A. legionensis*, isolated far northward on the Sierra Madre Oriental in Nuevo León; this resembles it in habit of growth but differs in its longer, looser indumentum of lustrous hairs and by the glabrous gynoecium. The four collections of var. *Hintoni* that I examined are alike in almost all details except that in the type-series the racemes are mostly 3–6, rarely 7-flowered, whereas they are about 8–14-flowered in the material from Nevado de Toluca and Cerro San Andrés, in this one respect resembling var. *cofrensis*.

13b. ASTRAGALUS HINTONI var. COFRENSIS

Stems above ground up to 10 (15) cm. long; *stipules* 1.2–3.5 mm. long, all connate into a bidentate sheath, the upper ones not much longer than the lowest; *peduncles* 0.5–1.5 cm. long, all much shorter than the leaf; *racemes* 5–10-flowered; *calyx* 6.4–6.9 mm. long, the white-strigulose teeth 1.9–2.6 mm. long; *keel* 9.8–10.2 mm. long, the claws 5.4–5.8 mm., the blades 5.2–5.4 mm. long—Collections: 1 (the typus).

In open pine woods and in thin turf, about 10,200 feet, known only from the Cofre de Perote, Vera Cruz.—Map No. 8.—May to July, probably later.

ASTRAGALUS HINTONI var. COFRENSIS (of Cofre de Perote), var. nov., a var. *Hintoni* stipulis, bracteis (herbaceis), calycisque dentibus brevioribus, petalis paullo longioribus magis exsertis, necnon ovario glabro absimilis.—VERA CRUZ: Cofre de Perote above Los Pescados, 10,200 feet, May 25, 1938, *E. K. Balls & W. B. Gourlay No. B-4624*.—Holotypus, NY! isotypi, K, UC, US!

Although much remains to be learned about the distribution and geographical variants of the Mexican *Strigulosi*, the pattern of narrow endemism presented by the material available at mid-century is probably real and no chance reflection of inadequate collecting. With this probability in mind, I have ventured to distinguish two varieties of *A. Hintoni*, even though each is known from only one or two gatherings and even though they differ in comparatively minor characters, the importance or constancy of which can hardly be foretold. The var. *cofrensis* is the more floriferous form, with (on the average) a few more flowers to the raceme, and its petals are a little longer absolutely (considerably so relative to the calyx, and appearing further exserted in consequence). The coincidence in var. *cofrensis* of short bracts, short stipules, and short calyx-teeth, which in *Astragalus* often vary in length together, is properly interpreted as a single difference. Since in *A. tolucanus* there are examples of glabrous and strigulous fruits from the same mountain, it is perhaps unwise to stress too heavily the glabrous ovary of var. *cofrensis* as a differential character.

The collectors describe var. *cofrensis* as having trailing stems up to 12 cm. in length and fragrant, mauve-purple flowers in heads which lie more or less prostrate. The stolon-like caudex-branches may reach a length of 3 dm. (and probably more) and give rise at intervals to adventitious roots.

14. ASTRAGALUS TOLUCANUS

Perennial, with a stout, woody taproot and shortly branching caudex or shallowly buried root-crown, thinly strigulose with appressed or subappressed hairs up

to 0.2–0.4 mm. long, the herbage green, the leaflets glabrous above; *stems* mostly numerous, diffuse and decumbent, (0.5) 1–5 dm. long, slender and occasionally branched below, simple and stouter distally; *stipules* dimorphic, the lowest ones amplexicaul and connate into a membranous, finally papery sheath 1.5–2.5 mm. long with short, triangular free blades, the median and upper ones subherbaceous, lanceolate, 3–6 mm. long, connate only at base; *leaves* shortly petioled, 2–8 cm. long, with (15) 19–25 oblong, ovate-oblong, or narrowly oblong-elliptic, retuse, truncate, or obtuse, flat or loosely folded leaflets 3–12 mm. long; *peduncles* slender, 2.5–11 cm. long; *racemes* 15–30-flowered, quite dense in early anthesis, looser in age, the flowers spreading and then declined, the axis 2–7 cm. long in fruit; *bracts* membranous, pallid or purplish, oblanceolate, elliptic, linear-oblong, or obovate, 3.5–6 mm. long, 0.8–2 mm. wide; *bracteoles* 0–2, when present membranous, minute or up to 3.5 mm. long; *pedicels* at anthesis 1–1.5 mm. long, in fruit arched outward, a trifle thickened, 1.5–2 mm. long; *calyx* 6.5–9.2 mm. long, black-strigulose, the campanulate or somewhat vase-shaped tube 3.2–4.5 mm. long, 2.3–2.8 mm. in diameter, the lanceolate teeth 3–4.7 mm. long, the whole becoming papery, marcescent unruptured; *petals* pink-purple, the banner prominently striate with purple veins; *banner* gently recurved through ±40°, oblanceolate or oblanceolate-cuneate, shallowly notched, 10.5–13 mm. long, 4–6 mm. wide; *wings* 9.5–10.5 mm. long, the claws 4.1–4.8 mm., the oblanceolate or narrowly oblong, obtuse, nearly straight blades 6.4–7.7 mm. long, 1.5–2.3 mm. wide; *keel* 7.8–8.4 mm. long, the claws 3.8–4.8 mm., the half-obovate blades 4–4.5 mm. long, 2.2–2.6 mm. wide, incurved through 90–100° to the blunt deltoid apex; *pod* pendulous, stipitate, the stipe 2–3 mm. long, the oblong-ellipsoid body 10–15 mm. long, 4–6 mm. in diameter, straight or nearly so, cuneately contracted at both ends, shortly apiculate at apex, obcompressed with rounded angles and openly sulcate dorsal face, the thin, green, glabrous or minutely black-strigulose valves becoming papery, brownish, finely cross-reticulate, inflexed as a partial septum 0.6–0.8 mm. wide; *dehiscence* unknown; *ovules* (5) 8–14; *seeds* brown, smooth, ± 2 mm. long.—Collections: 6 (o); representative: *Russell & Souviron 144* (CAS, US); *Hinton 1900* (K, NY, US); *Balls 5023* (K, UC, US).

Dry flats and slopes in pine forest and on stony banks and in open fields in the forest zone, 8450–12,000 feet, local in the high mountains of the State and Federal District of Mexico. —Map No. 8.—August to October.

ASTRAGALUS TOLUCANUS (of Nevado de Toluca, the extinct volcano) Robins. & Seat. in Proc. Amer. Acad. 28: 104. 1893.—"On drier ridges under pines, Nevado de Toluca, 12,000 ft., September, 1892 (No. 4238)."—Holotypus, collected by C. G. Pringle, GH! isotypi, BM, G, K, MINN, NY, OB, P, PH, US!—*Atelophragma tolucanum* (Robins. & Seat.) Rydb. in Bull. Torr. Club 55: 156. 1928. *A. tolucensis* (sphalm.) Urbina, Catal. Pl. Mex. 58. 1897, nomen.

Atelophragma bracteatum (with large bracts) Rydb. in Bull. Torr. Club 55: 161. 1928.—"Sierra de Toluca, State of Mexico, *Rose & Painter 7913*."—Holotypus, collected in October, 1903, NY! isotypus, US!

The volcano milk-vetch, *A. tolucanus,* is closely related to *A. guatemalensis,* from which it is distinguished by no single important character. It may be fated, as it becomes better known, to be reduced to varietal rank. In practice it is easily separated from the actually or very nearly sympatric *A. guatemalensis* var. *brevidentatus* by the prominently bracteate racemes and long, narrow calyx-teeth; and it would be premature to form an opinion as to its status until the dehiscence of the pod has been described. On the Nevado de Toluca the pod of *A. tolucanus* varies from glabrous to minutely pubescent, the latter state, described as *Atelophragma bracteatum,* being no more than an individual variation coordinate with the pubescent-fruiting forms of *A. guatemalensis* var. *brevidentatus.*

The species was collected first by Humboldt and Bonpland in 1803. Their single specimen, preserved in Bonpland's collection (P), is labeled "Jorullo," but the locality requires confirmation. A short diagnosis accompanying the specimen shows that Bonpland recognized the

species as undescribed; it was apparently not seen by Kunth and was thus overlooked in *Nova Genera & Species.*

I should add that the volcano milk-vetch, a pretty, floriferous species which might repay cultivation, has a certain individuality of aspect transcending its technical likeness to *A. guatemalensis* and suggestive of physiological or ecological differences of which herbarium specimens tell nothing. The purple-penciled veining of the banner is unusually prominent and attractive.

15. Astragalus strigulosus

Coarse, leafy, caulescent perennial, with a taproot and (probably, but seldom observed) shortly subterranean caudex, strigose-pilosulous nearly throughout with rather stiff, subappressed or narrowly incurved-ascending hairs up to 0.4–0.7 mm. long, the herbage cinereous or canescent in youth, sometimes greenish in age, the leaflets glabrous or marginally pubescent above; *stems* erect and ascending in clumps, 2–6 dm. long (perhaps longer late in the season), simple or branched at several nodes from near the base upward; *stipules* 3–9 mm. long, more or less dimorphic, the lowest connate through half their length or more into a papery-scarious sheath sometimes ruptured or even deciduous in age, the upper ones longer, lanceolate or deltoid-acuminate, either connate at base, or semiamplexicaul-decurrent and free; *leaves* 4–10 cm. long, subsessile, with 13–23 (29) oblong-oblanceolate, broadly or narrowly oblong-elliptic, obtuse and mucronulate, retuse, or rarely subacute, flat or loosely folded leaflets 6–18 (22) mm. long; *peduncles* rather stout, erect or incurved-ascending, (4) 5–10 cm. long, a little longer or shorter than the leaf; *racemes* (12) 15–35 (40)-flowered, dense in early anthesis, the flowers early declined and retrorsely imbricated, the axis somewhat elongating, (1.5) 2–9 cm. long in fruit; *bracts* membranous, pallid, linear-lanceolate, (1.5) 2–4.5 mm. long; *pedicels* at anthesis 0.5–1 mm. long, early arched outward and downward, in fruit thickened, 0.8–2 mm. long; *bracteoles* 0–2, commonly 0; *calyx* (5.2) 5.8–7.5 mm. long, pilosulous with black, fuscous, or mixed black and white hairs, the oblique disc 0.6–1 mm. deep, the campanulate tube 2.8–3.2 mm. long, (2.2) 2.5–2.8 mm. in diameter, the slenderly lance-subulate teeth (2.5) 3–4.3 mm. long, the ventral pair often shorter than the rest, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, immaculate; *banner* gently recurved through ± 40°, rhombic-obovate, obovate-spatulate, or elliptic-oblanceolate, shallowly or deeply notched, 9.2–11.5 mm. long, (4.2) 4.6–6 mm. wide; *wings* (7.7) 8.5–10.5 mm. long, the claws 3-3.5 mm., the narrowly oblanceolate, obtuse and erose, or obliquely truncate or emarginate, slightly incurved blades (5.5) 6–7.5 mm. long, (1.8) 2–2.5 mm. wide; *keel* 6.7–7.5 mm. long, the claws 3.1–3.5 mm., the half-obovate blades 4.2–4.7 mm. long, 2.1–2.6 mm. wide, abruptly incurved through 85–95° to the rounded, or more rarely deltoid and obtusely apiculate apex; *anthers* 0.4–0.55 mm. long; *pod* pendulous, stipitate, the stipe 2–4 mm. long, the body ellipsoid to plumply oblong-ellipsoid, 12–17 (20) mm. long, (4.5) 5–7 mm. in diameter, about 2–3 times longer than wide, straight or a trifle decurved, broadly cuneate at both ends, shortly apiculate-beaked, dorsiventrally compressed, low-carinate ventrally by the suture, openly sulcate dorsally, the thinly fleshy, green, glabrous or (rarely) white- or black-puberulent valves becoming rather stiffly papery, stramineous, cross-reticulate, inflexed as an incomplete or nearly complete septum 0.8–1.6 mm. wide; *dehiscence* basal and upward through the proximal half of the dorsal suture and the septum; *ovules* 14–18 (19); *seeds* brown or olivaceous, dull, smooth, 1.8–2.1 mm. long—Collections: 11 (o); representative: *Rose, Painter & Rose 8835* (NY, US); *Pringle 10,311* (CAS, GH, MICH, NY, P, US), *13,263* (GH, MICH, US); *Matuda 21,883* (NY); *E. W. Nelson 1940* (NY, US); *Bourgeau 700* (G, P).

Dry, open hillsides and mesas, on either calcareous or volcanic bedrock, about

7000 to 8650 feet, apparently rather local, Valley of Mexico (State and D. F.), southern Hidalgo, and northwestern Oaxaca.—Map No. 8.—May to November.

ASTRAGALUS STRIGULOSUS (roughly hairy) Kunth in H. B. K., Nov. Gen. & Sp. 6: 386. 1823.—"Crescit in temperatis Regni Mexicani, prope Morán, alt. 1330 hex."—Typus, collected in 1803 by Alexander von Humboldt and Aimé Bonpland, P (herb. H. B. K.)!—Morán, or Real de Morán, is in s. Hidalgo, between Pachuca and Actopán, acc. Sprague in Kew Bull. 1924, p. 22.—*Tragacantha strigulosa* (Kunth) O. Kze., Rev. Gen. 948. 1891. *Atelophragma strigulosum* (Kunth) Rydb. in Bull. Torr. Club 55: 158. 1928.

Although historically the prototype of its section, *A. strigulosus* is a comparatively rare and local species which has often been misinterpreted and never adequately disentangled from the related *A. guatemalensis;* the record has become badly confused by the use of the epithet *strigulosus* for almost any Mexican species at all similar in general facies. Thus among the collections cited by Hemsley (1880, p. 266) are several now referred to *A. guatemalensis* var. *brevidentatus,* and an isotypus of *A. potosinus.* So far as I can learn, Jones (1923) included *A. strigulosus* of this work in his *A. guatemalensis,* transferring the epithet to a vaguely defined, small-flowered astragalus akin to *A. Rusbyi* which represents a type of *Strigulosi* found in northcentral Mexico and southwestern United States but absent from the central plateau. (see our *A. longissimus*). Likewise Rydberg (1928, p. 158) listed as *Atelophragma strigulosum* a mixture of the genuine species and *A. guatemalensis* var. *brevidentatus* (e.g. *Purpus 2681, 3209; E. W. Nelson 1427,* all NY, US). Apparently his reliance on a longer stipe as the best diagnostic character of *A. strigulosus* led him into error, for there is some overlapping between the two species in this respect. In the foregoing key I have pointed out what seems to be a significant difference in the dehiscence of the pod, but in practice *A. strigulosus* is more easily distinguished from *A. guatemalensis* var. *brevidentatus* by its ochroleucous flowers and long-toothed, loosely black- or fuscous-hairy calyx. It is also a more erect and sturdy plant, apparently confined to sunny situations in the valleys and open foothills, whereas *A. guatemalensis* is found in a cooler environment of pine woods and shady ravines or barrancas in the mountains. The species varies little. The pod, as originally described, is normally glabrous, but there is one collection from near the type-locality in Hidalgo (10 miles south of Actopán, *Fearing & Thompson 84,* TEX) in which the valves are beset with very short, scattered hairs, either wholly black or black and white intermingled. Minor variants of the same sort are known in *A. tolucanus* and *A. guatemalensis* var. *brevidentatus.*

Specimens apparently referable to *A. strigulosus* but too young for certain determination were collected by Parry & Palmer (*No. 169,* GH, NY) ostensibly in the region of San Luis Potosí, where *A. potosinus* and *A. tioides* are the *Strigulosi* most likely to be encountered. Pending verification of the record, which may be based in error, I have omitted this range extension from the map.

16. ASTRAGALUS LYONNETII

Low, slender, caulescent perennial, with a taproot and shallowly buried root-crown, loosely strigulose-pilosulous with fine, subappressed or narrowly ascending, straight or largely straight hairs up to 0.35–0.6 mm. long, the herbage green or cinereous in youth, the leaflets glabrous above, the inflorescence black- or fuscous-pilose; *stems* 5–30 cm. long, simple or nearly so, weakly ascending or when young perhaps erect, floriferous from 1–2 nodes above the middle; *stipules* dimorphic, those at the lowest nodes amplexicaul and connate into a brown, papery, glabrous, shortly bidentate sheath 1–3 mm. long, the upper ones longer and narrower, up to 8 mm. long, submembranous, pubescent dorsally, connate through ± half their length, with erect, lanceolate free blades; *leaves* 3–6.5 cm. long, subsessile, with slender rachis and (9) 15–25 (27) linear-oblong, -oblanceolate, or narrowly elliptic, truncate or emarginate, flat or loosely folded leaflets (2) 3–12 mm. long; *peduncles* slender, erect, 4.5–11 cm. long, surpassing the leaf; *racemes* short and moderately dense, 13–20-flowered, the flowers at first ascending, declined in age, the axis little elongating, up to 2.5 cm. long in fruit; *bracts* membranous, pallid, narrowly lanceolate or linear-acuminate, 2.5–5 mm. long; *pedicels* at anthesis ascending, straight, 1.2–2 mm. long, in fruit arched outward, a little thickened, up to 3.5 mm. long; *bracteoles* 0; *calyx* 5.2–7.4 mm. long, pilosulous with fuscous, and sometimes a few white hairs, the somewhat oblique disc 0.7–1.1 mm. deep, the

campanulate tube 2.9–4.3 mm. long, 2.3–2.8 mm. in diameter, the lance-subulate teeth 2.3–3.8 mm. long; *petals* apparently ochroleucous, pale yellow when dry, immaculate; *banner* recurved through ±40°, rhombic-oblanceolate or -elliptic, shallowly notched, 10–12.4 mm. long, 4.2–5.2 mm. wide; *wings* 9.5–9.8 mm. long, the claws 4–4.6 mm., the linear-oblong or -oblanceolate, obtuse or subemarginate, nearly straight blades 6.6–7.1 mm. long, 1.6–2 mm. wide; *keel* 7.7–8.7 mm. long, the claws 4–4.7 mm., the half-obovate blades 4.5–5 mm. long, 2.1–2.3 mm. wide, abruptly incurved through 85–90° to the rounded or rather sharply deltoid apex; *anthers* 0.4–0.5 mm. long; *pod* pendulous, stipitate, the stipe ± 3 mm. long, the body oblong-ellipsoid, 1–1.4 cm. long, ± 3.5 mm. in diameter, cuneate at base, contracted at apex into an erect cusp ± 1.5 mm. long, obtusely trigonous, convex ventrally, openly grooved dorsally, the thin, green, minutely black-strigulose valves becoming papery, brown, cross-reticulate; *dehiscence* and *seeds* unknown; *ovules* 15–18.—Collections: 4 (o); representative: *E. Lyonnet 176* (GH, K, MO, NY, US); *Schnooberger 8566* (MICH).

Open pine woods, ± 9000–9800 feet, perhaps sometimes lower, apparently uncommon, known only from the mountains bordering the Valley of Mexico to the south, Mexico State and Federal District, and adjoining Morelos.—Map No. 8—July to September.

Astragalus Lyonnetii, sp. nov., *A. strigulosо* Kunth arcte (fortasse nimium) affinis, praesertim caulibus gracilioribus et brevioribus necnon legumine breviori et angustiori absimilis. A *Strigulosis* sympatricis *A. guatemalensi* var. *brevidentato* calycis dentibus elongatis petalisque flavidis immaculatis, *A. micrantho* var. *micrantho* floribus multo majoribus et legumine stipitato, *A. radicanti* var. *Harshbergeri* stipularum forma necnon caulibus diffusis sed minime reptantibus facilius separatur.—Caules graciles 5–30 cm. longi; *folia* 3–6.5 cm. longa foliolis 7–12 (13)-jugis lineari-oblongis ellipticisve (2) 3–12 mm. longis supra glabris; *racemi* breves 13–20-flori fructiferi parum elongati; *calycis* 5.2–7.4 mm. longi dentes lanceolato-subulati 2.3–3.8 mm. longi; *corolla* flavida immaculata, vexillo leviter recurvo 10–12.4 mm., alis inter se symmetricis 9.5–9.8 mm., carina 7.7–8.7 mm. longis; *legumen* pendulum stipitatum, praeter stipitem ± 3 mm. longum oblongo-ellipsoideum 1–1.4 mm. longum basi cuneatum obtuse trigonum dorso aperte sulcatum, valvulis demum chartaceis atro-strigillosis; *ovula* 7–9-juga.—Morelos: Toro, 9800 feet, August 5, 1924, *G. L. Fisher 260.*—Holotypus, US!

The Lyonnet milk-vetch might be described as a slender version of *A. strigulosus* with a shorter and narrower, apparently always pubescent pod. Whereas *A. strigulosus* is a plant of dry, sunny habitats in the valleys and lower foothills, *A. Lyonnetti* is found in the mountain pine forests, sometimes associated with *A. micranthus.* At first I confused the species with *A. radicans* var. *Harshbergeri,* which it resembles in details of the flower and pod; the latter has broader stipules and truly prostrate stems rooting adventitiously at the nodes. Another sympatric member of the section, *A. guatemalensis* var. *brevidentatus,* is in nearly all cases distinguished by its purple flower and glabrous pod, the rare exceptions being much taller than *A. Lyonnetii,* often vinelike in stature, and distinguished by the technical character of abbreviated calyx-teeth. Ripe fruit of the Lyonnet milk-vetch showing the dehiscence are required before the nature of its relationship to *A. strigulosus* can be assessed.

17. Astragalus radicans

Doubtless perennial, but the root-stock or caudex and the root unknown, the stems stramineous, glabrescent, the herbage green, the leaflets glabrous above, strigulose beneath with appressed or subappressed hairs up to 0.4–0.6 mm. long, the inflorescence black-hairy; *stems* prostrate, 1.5–8 dm. long or possibly longer, apparently elongating indefinitely during the season of growth, simple or few-branched, creeping along the ground and often rooting at the nodes; *stipules* 1.5–9 mm. long, those at the flowering nodes broadly obovate or suborbicular, herbaceous except for the pallid base, connate through ± half their length, much broader than the stem, glabrous or nearly so dorsally; *leaves* 3–32 cm. long, all petioled,

the opposite or scattered leaflets 17–31, broadly lanceolate, oblong, elliptic, or linear-lanceolate, obtuse, truncate and apiculate, or acute, flat, 3–25 mm. long; *peduncles* 2–26 cm. long; racemes 7–30-flowered, the flowers early declined, the axis little elongating, 1.5–5 cm. long in fruit; *bracts* membranous, pallid, ovate or oblong- to obovate-elliptic, obtuse or acute, (1.5) 2–4 mm. long, reflexed in age; *pedicels* at anthesis 0.5–1 mm. long, early arched outward, in fruit thickened, 0.7–2 mm. long, persistent; *bracteoles* 0; *calyx* 7.5–8.7 mm. long, strigulose or strigulose-hirsutulous with mostly black hairs, the subsymmetric disc 1–1.2 mm. deep, the campanulate, pallid tube 4.1–5.1 mm. long, 2.7–3.5 mm. in diameter, the lanceolate teeth 3–5 mm. long, the ventral pair broader but hardly shorter than the rest, the whole becoming papery, marcescent; *petals* ochroleucous or yellowish, perhaps sometimes faintly purple-tinged when fresh; *banner* recurved through 40–45°, broadly elliptic, oblong-oblanceolate, or ovate-cuneate, shallowly notched, (11.5) 12–14.6 mm. long, 5–7 mm. wide; *wings* 11–13.8 mm. long, the claws 4.4–6 mm., the narrowly oblong or elliptic, obtuse or emarginate, nearly straight blades 8–9.4 mm. long, 2–2.7 mm. wide; *keel* 8–10.2 mm. long, the claws 4.4–5.4 mm., the half-obovate blades 4.2–5.5 mm. long, 2.4–3 mm. wide, abruptly incurved through ±95° to the obtusely deltoid apex; *anthers* 0.45–0.6 mm. long; *pod* reflexed, subsessile or shortly stipitate, the stipe up to 1 mm. long, the body oblong or oblong-elliptic in dorsiventral view, straight or nearly so, 1.5–2.1 cm. long, 5–8 mm. in diameter, rounded or cuneate at base, abruptly apiculate-beaked, decidedly obcompressed, obtusely carinate ventrally by the suture, openly and shallowly sulcate dorsally, the rather stiffly papery, black- or partly white-strigulose valves inflexed as an incomplete septum (0.5) 1–1.6 mm. wide; *dehiscence* apical and downward through both sutures and the septum; *ovules* 17–31; *seeds* chestnut-brown, smooth, dull, 1.8–2.6 mm. long.

The creeping milk-vetch, *A. radicans,* is the only astragalus known to produce rootlets in the manner of *Apium repens* Rchb. f. from flowering nodes of truly prostrate stems. The pod is quite similar in form to that of *A. strigulosus* and *A. guatemalensis,* but is only very shortly stipitate or subsessile. The long-toothed calyx and ochroleucous flowers are like those of the former species, but the pod dehisces downward from the apex through both sutures as in *A. guatemalensis,* not only ventrally at the base. The species has apparently differentiated out into two forms, one of them found on the floor of the Valley of Mexico at about 7000 feet, the other at about 11,000 feet in the neighboring mountains.

There seems to be no alternative to taking up for this species the slightly earlier *A. radicans* in place of the more familiar *A. reptans,* the name used by Jones (1923, p. 191) and Rydberg. Horneman and Willdenow's proposals were based on plants grown in the botanic gardens of Berlin and Copenhagen from seeds collected by Humboldt and Bonpland in Mexico. Both authors believed that they were publishing a name of Humboldt's, and their descriptions equally well characterize the species. It is not known whether any Humboldt specimen has survived. Kunth (Nov. Gen. & Sp. (Folio) 6: 386) saw only cultivated specimens of *A. reptans,* but material collected in Mexico is to be sought in the Willdenow herbarium. The excellent plate in *Hortus Berolinensis* leaves no doubt about the identity of the plant in cultivation at the time, and a number of cultivated specimens have survived: Hort. Paris., 1818 (P), 1822 (K, ex herb. Gay.), 1827 (P), 1828 (P); Hort. Berol. (P, as *A. radicans*); without date, "cult., M. Bonpland," (P).

Key to the Varieties of A. radicans

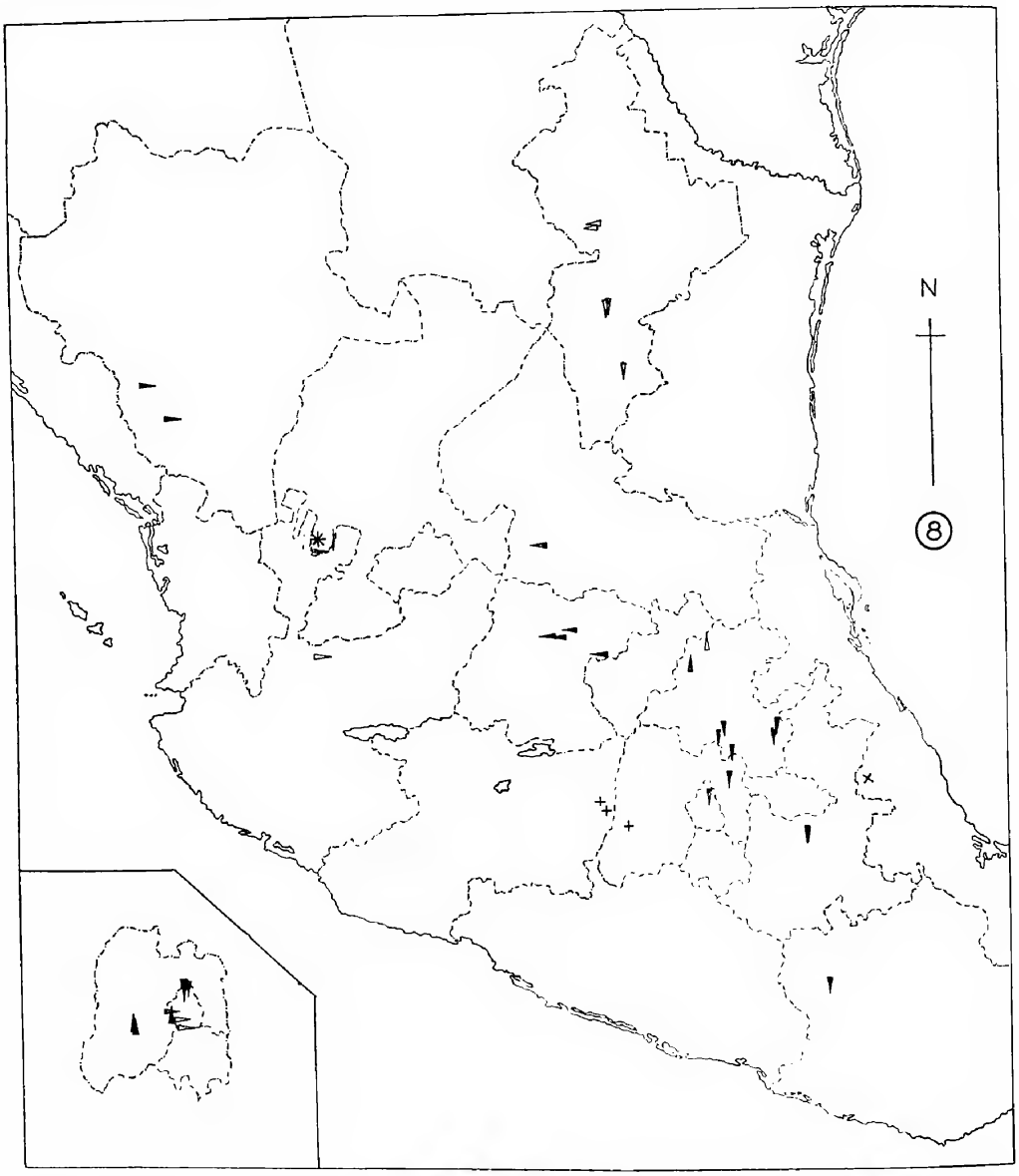
1. Stems coarse, 2–8 dm. long; *herbage* comparatively rank, the leaves (7) 10–32 cm. long, with 21–31 leaflets (6) 10–25 mm. long; *peduncles* vertically erect, 1–2.6 dm. long; *racemes* densely (15) 20–30-flowered, the fruits retrorsely imbricated; *ovules* 20–31; floor of the Valley of Mexico ..... 17a. var. *radicans*

1. Stems slender, 1.5–3 dm. long; *herbage* relatively sparse, the leaves 3–7 cm. long, with ± 17 leaflets 3–10 mm. long; *peduncles* incurved-ascending, 2–7 cm. long; *racemes* loosely 7–12-flowered; *ovules* 17–18; Sierra de las Cruces, at ± 11,000 ft. ..... 17b. var. *Harshbergeri*

17a. Astragalus radicans var. radicans

Stipules at the lower nodes not seen, those at the fertile nodes (3) 5–9 mm. long; *raceme-axis* 2–5 cm. long in fruit; otherwise as given in the key.—Collections: 6 (o); representative: *Pringle 6315* (CAS, G, GH, K, ND, NY, P, US); *Bilimek 107* (NY, P, US); *Bourgeau 481* (K, P).

Grassy knolls in low-lying meadows, ±7000–7300 feet, known only from the floor of the Valley of Mexico in the environs of Ciudad México.—Map No. 8.—May to October.



Map No. 8. Central Mexico. Range of ▼ *A. strigulosus*; of *A. hidalgensis*: ▲ var. *hidalgensis*, and △ var. *protensus*; of ♦ *A. potosinus*; of * *A. zacatecanus*; of ◊ *A. jaliscensis*; of ◊ *A. regiomontanus*; of ♦ *A. Pennellianus*; of *A. Hintoni*: + var. *Hintoni*, and × var. *cofrensis*; and of ▽ *A. legionensis*. Inset, lower left, Mexico State and Federal District. Range of ▲ *A. tolucanus*; of ◊ *A. Lyonnetii*; and of *A. radicans*: ▼ var. *radicans*, and ♦ var. *Harshbergeri*.

ASTRAGALUS RADICANS (rooting at the nodes) Humb. ex Hornem., Hort. Havn. 708. 1815. —"Hab.— —F. intr. 1808 *sub nom.* Astr. radicans Humb."—No typus examined; to be sought at C; certainly identifiable from description and origin!

Astragalus reptans Humb. & Bonpl. ex Willd., Hort. Berol. 2: 88, Tab. 88. 1816.—"Astragalus reptans *de Humboldt et Bonpland.*... Habitat in Mexico."—No typus examined; to be sought in herb. Willd. (B); certainly identifiable from description, accompanying plate, and contemporary cultivated material cited supra!—*Tragacantha reptans* (Humb. & Bonpl.) O. Kze., Rev. Gen. 947. 1891. *Atelophragma reptans* (Humb. & Bonpl.) Rydb. in Bull. Torr. Club 55: 159. 1928.

The creeping milk-vetch is one of the curiosities of the genus. The stems apparently elongate indefinitely during the season of growth and are pressed close to the ground, giving rise at each of the upper nodes to a leaf and what must appear in nature to be a scapose peduncle which bears aloft a dense, oblong head of creamy-white or perhaps faintly purple-tinged flowers which are followed by crowded, retrorsely imbricated pods. A rootlet develops from the lower side of the stem opposite each peduncle; since Willdenow says that the plant was propagated at the Berlin Botanic Garden by means of offsets, the adventitious roots can evidently assume the function of the original taproot. This method of self-perpetuation is quite analogous to that found in some *Scytocarpi* and *Cusickiani*, but in them the adventitious roots arise only from subterranean nodes. The species is evidently very local and has not been collected, to my knowledge, within the past fifty years. Probably its numbers have become depleted by expansion of Mexico City and especially by alteration of the water table in the Valley of Mexico and consequent desiccation of the meadows where it formerly found a home.

The earliest known collection of var. *radicans* is one in the Sessé and Mociño collection (*No. 3763,* MA), made probably in the last decade of the XVIII century. There are duplicates at BM (ex herb. Ruiz & Pavón) and (labeled "Nueva España") at OXF.

17b. ASTRAGALUS RADICANS var. HARSHBERGERI

Stipules at the lower nodes small, scarious or early becoming so, connate into a cuplike sheath, the later ones much larger, up to 5 mm. long; *raceme-axis* 1.5–2.5 cm. long in fruit; otherwise as given in the key.—Collections: 1 (typus only).

Habitat not recorded, but to be sought in moist mountain meadows or around seeps in the pine belt, ± 11,000 feet, known only from the type-locality in the Sierra de las Cruces (at the northern end of Serranía de Ajusco) near the west boundary of the Federal District, State of Mexico—Map No. 8.—July to September, probably later.

ASTRAGALUS RADICANS var. HARSHBERGERI (Rydb.), stat. nov., based on *Atelophragma Harshbergeri* (John William Claghorn Harshberger, 1869–1929, Pennsylvania botanist, student of the New Jersey pine barrens) Rydb. in Bull. Torr. Club 55: 160. 1928.—"The type was collected at Salazar, Sierra de las Cruces, August 13, 1896, *J. W. Harshberger 20*..."—Holotypus, collected at 11,000 ft., GH! isotypus, US!

The typus of *Atelophragma Harshbergeri* was distributed as *Astragalus reptans* (our var. *radicans*), and it was recognized as representing a close relative of that species by Rydberg. The adventitious roots, exceptionally broad stipules at the flowering nodes, flowers, and (despite Rydberg's description) the fruits also are essentially alike in both. However var. *Harshbergeri* is a much more slender plant than var. *radicans*, with shorter leaves, fewer and smaller leaflets, much shorter, incurved-ascending and not vertically erect peduncles, and fewer and more loosely racemose flowers and fruits. These features may prove to be somewhat variable, but for the present we are justified in according var. *Harshbergeri* varietal rank.

18. ASTRAGALUS POTOSINUS

Caulescent perennial, with a woody taproot and subterranean root-crown, pilosulous nearly throughout with rather stiff, ascending or subappressed, straight or partly sinuous hairs up to 0.4–0.7 mm. long, the stems and young herbage commonly cinereous, the leaflets glabrous above; *stems* rather slender, apparently ascending, leafless at base, (0.7) 1.5–5 dm. long, simple or spurred at 1–4 nodes preceding the first peduncle; *stipules* 1.5–6 mm. long, dimorphic, the lowest early becoming papery, castaneous, nearly glabrous, connate into an amplexicaul, cam-

panulate, bidentate sheath, the upper ones deltoid or lanceolate, connate through half their length or less, pubescent dorsally; *leaves* (1.5) 2.5–6 cm. long, the lowest shortly petioled, the rest subsessile, with (11) 15–21 (23) obovate, oblong-obovate, or broadly oblanceolate, emarginate or truncate-obtuse (sometimes also minutely apiculate), flat leaflets (2) 3–9 mm. long; *peduncles* erect or incurved-ascending, (3) 4.5–15 cm. long, usually much surpassing the leaf; *racemes* loosely (8) 10–20-flowered, the flowers early nodding, the axis elongating, (1.5) 2.5–7 cm. long in fruit; *bracts* membranous, lanceolate or linear-lanceolate, 2–4 mm. long; *pedicels* at anthesis ascending, 0.5–1 mm., in fruit strongly arched outward or recurved, thickened, 1.3–2.2 mm. long, persistent; *bracteoles* 0; *calyx* 4.1–6.1 mm. long, ascending-pilosulous with white or largely black hairs, the somewhat oblique disc 0.5–0.9 mm. deep, the campanulate tube 2.4–3.3 mm. long, 2.2–2.7 mm. in diameter, the slenderly subulate teeth 1.5–3 mm. long, the dorsal one sometimes shortest, the ventral pair broadest, the whole becoming papery, marcescent unruptured; *petals* purple or purplish, drying bluish or ochroleucous; *banner* recurved through ± 40°, broadly oblanceolate or ovate-cuneate, shallowly notched, 7.4–8.4 mm. long, 3.9–4.6 mm. wide; *wings* (0.3 mm. shorter to 0.2 mm. longer) 7.1–8.3 mm. long, the claws 2.7–3.2 mm., the narrowly oblong or oblanceolate, obtuse or erose-emarginate, slightly incurved blades 5.1–6.1 mm. long, 1.5–2.1 mm. wide; *keel* 5.8–6.3 mm. long, the claws 2.8–3 mm., the half-obovate blades 3–4 mm. long, 1.9–2.1 mm. wide, incurved through ± 95° to the sharply or bluntly deltoid apex; *anthers* 0.4–0.5 mm. long; *pod* pendulous, stipitate, the stipe (2) 3–5 mm. long, the body linear- or narrowly oblong-elliptic in dorsiventral view, straight, 1.4–2.5 cm. long, 4–6 mm. in diameter, ± 4–5 times longer than wide, dorsiventrally compressed, bluntly carinate ventrally by the suture, openly and shallowly sulcate dorsally, the thin, green, thinly white- or fuscous-strigulose valves becoming papery, stramineous or ultimately dark brown, reticulate, inflexed as an incomplete septum 0.5–0.7 mm. wide; *dehiscence* apparently (at least at first) basal, through the dorsal suture and the septum; *ovules* 10–15; *seeds* dark brown, smooth, sublustrous, 1.7–2 mm. long.—Collections: 7 (ii); representative: *Schaffner 615/812* (CAS, GH, K, NY, P); *McVaugh 10,399* (MICH, RSA); *Ripley & Barneby 13,371* (NY, RSA); *Waterfall 15476a* (NY).

In oak forest, ± 8200–8650 feet, and probably lower, apparently local, known from scattered stations in the valley of San Luis Potosí and adjoining Guanajuato; also, seemingly disjunctly, in the Sierra Madre Occidental in Durango (near El Salto).—Map No. 8.—April to September.

ASTRAGALUS POTOSINUS (of San Luis Potosí), sp. nov., *A. strigulosо* Kunth arctissime affinis sed legumine longiori angustiori densiuscule striguloso (nec glabro vel vix puberulo), dentibus calycinis brevioribus (1.5–3 nec 3–5 mm. longis), necnon floribus minoribus minus numerosis laxius racemosis absimilis.—Caules graciles (0.7) 1.5–5 dm. longi; *folia* (1.5) 2.5–6 cm. longa foliolis (5) 7–10 (11)-jugis (2) 3–9 mm. longis; *racemi* laxe 8–20-flori; *calyx* ± 4–6 mm. longus, dentibus 1.5–3 mm. longis; *flores* parvuli purpurascentes vexillo ± 7.5–8.5 mm., carina 5.8–6.3 mm. longis; *legumen* pendulum lineari- vel anguste oblongo-ellipsoideum basi in stipitem (2) 3–5 mm. longum attenuatum 1.4–2.5 cm. longum 4–6 mm. latum obcompressum dorso aperte sulcatum densiuscule strigulosum semibiloculare 10–15-ovulatum.—SAN LUIS POTOSI: sine loc., 1878, *C. C. Parry & Ed. Palmer 175*.—Holotypus, NY! isotypi, GH, K, P!—*Atelophragma potosinum* Rydb. in Bull. Torr. Club 55: 160. 1928, pro parte, exclus. basonym. & isotypo fallaci in herb. GH.

The pod of *A. potosinus* dehisces like that of *A. strigulosus* primarily at base, and these two species are close kindred. The Potosí milk-vetch differs from its relative in the narrower outline of the fruit, which varies from four to five rather than from two to three times longer than wide. The flower of *A. potosinus* is a little smaller than that of *A. strigulosus*, the calyx-teeth are decidedly shorter, and the racemes are looser and composed of fewer flowers. The pod of *A. strigulosus* is ordinarily glabrous, only rarely beset with a few scattered hairs, that of

A. potosinus is consistently and quite densely strigulose. The differential characters are nevertheless rather weak ones, and it is possible that *A. potosinus* should be treated more realistically as a variety. In Durango the range of *A. potosinus* overlaps that of *A. Pennellianus* from which it is, however, easily distinguished by its comparatively few (15–23, not 25–41) leaflets.

Although *A. potosinus* has been described above as a new species, it is substantially equivalent to *Atelophragma potosinum* Rydb. The epithet *potosinum* was suggested by the Parry and Schaffner collections from San Luis Potosí, the material on which the description of *Atelophragma potosinum* in *North American Flora* was principally based. In the original publication, however, *A. potosinum* was proposed as a direct substitute, at the specific level, for Hemsley's *A. strigulosus* var. (?) *gracilis,* which it must inevitably follow into the synonymy of *A. hidalgensis.* When Rydberg identified his Potosí milk-vetch with Hemsley's variety, he was misled by a specimen at GH which was distributed as *Coulter 631* from Zimapán in Hidalgo but is in reality part of *Coulter 632* from Sierra de Pachuca and represents not the real var. *gracilis* (= *Coulter 631* at K) but *A. guatemalensis* var. *Lozani.* Thus the plant believed to be authentic for var. *gracilis* was neither a genuine isotypus nor even conspecific with the material from San Luis Potosí that provided the critical differential characters of his species. The proposal of a new *Astragalus potosinus* in these pages should effectively forestall transfer of Rydberg's epithet *potosinum* to *Astragalus.*

19. Astragalus zacatecanus

Perennial, strigulose with appressed hairs up to 0.5 mm. long; *stems* apparently decumbent, nearly 4 dm. long, somewhat branched; *stipules* 2.5–7 mm. long, all connate, the upper ones more shortly than the lower; *leaves* 4.5–7.5 cm. long, the upper ones subsessile, with 9–17 oblong to oblanceolate, obtuse or emarginate leaflets 5–20 mm. long, glabrous above; *peduncles* 8–10 cm. long, surpassing the leaf; *racemes* 30–55-flowered, early becoming loose, the flowers early declined, the axis 10–18 cm. long in fruit; *pedicels* at anthesis 1–1.4 mm. long, arched outward, thickened, 2.5–4 mm. long in fruit; *bracteoles* 0; *calyx* 6.1–7 mm. long, hirsutulous with mixed dark and pale hairs, the disc about 0.8 mm. deep, the campanulate tube 2.8–3.1 mm. long, 2.5–2.7 mm. in diameter, the lance-subulate teeth 3–4 mm. long; *petals* apparently ochroleucous, immaculate; *banner* recurved through 45°, rather narrowly obovate-cuneate, 8.3–9 mm. long, 3.7–4.5 mm. wide; *wings* 7.6–9 mm. long, the claws 3–4 mm., the narrowly oblong, obtuse, slightly incurved blades 5.6–6 mm. long, about 1.5 mm. wide; *keel* 6.2–7 mm. long, the claws 2.8–3 mm., the half-obovate blades 4–4.3 mm. long, 2.1 mm. wide, incurved through 90° to the bluntly deltoid, or slightly porrect apex; *anthers* 0.4 mm. long; *pod* pendulous, stipitate, the stipe ± 3 mm. long, the body narrowly oblong-ellipsoid, 1.5–2.3 cm. long, 5–6 mm. in diameter, straight, cuneate at both ends, contracted apically into a subulate cusp 1.5–2.5 mm. long, openly sulcate dorsally, the papery valves glabrous, inflexed as an incomplete septum 0.7 mm. wide; *ovules* 20–24; *dehiscence* and *seeds* unknown.—Collections: typus only.

Habitat unknown, but to be looked for in oak-pine forest at middle elevations, southwestern Zacatecas.—Map No. 8—July to September (?)

Astragalus zacatecanus (Rydb.), comb. nov., based on *Atelophragma zacatecanum* Rydb. in Bull. Torr. Club 55: 157. 1928.—"The type was collected in the state of Zacatecas, in 1897, *Rose 2638* . . ."—Holotypus, NY! isotypi, GH, and with additional data: "near Monte Escobedo," i.e., in s.-w. Zacatecas, US!

The Zacatecas milk-vetch, like the next species, is known only from the typus, and it is impossible to foresee in what measure future botanical exporation of central Mexico will affect their status. Both species are evidently related to *A. strigulosus* but differ in their elongated fruits of slender outline which enclose ten to twelve pairs of ovules. The present species is chiefly remarkable for its very numerously flowered, at length elongate racemes, and differs further from *A. jaliscensis* in its comparatively few leaflets and slightly smaller flowers.

20. Astragalus jaliscensis

Perennial, with a stout, woody taproot, thinly appressed-pilosulous with straight hairs up to 0.4–0.5 mm. long, the herbage green, the leaflets glabrous

above; *stems* erect, 2–3.5 dm. long, simple or branched at 1–3 nodes preceding the first peduncle, sometimes spurred between the peduncle and its subtending leaf; *stipules* 3–5.5 mm. long, dimorphic, the lower ones connate through half their length or more into an amplexicaul sheath, the upper ones narrowly lanceolate, free to the base or nearly so; *leaves* subsessile, 3–7 cm. long, with 19–29 ovate to suborbicular, or (in some upper leaves) elliptic, emarginate or obtuse, flat leaflets 3–12 mm. long, all rather crowded on the rachis, thin-textured, paler beneath; *peduncles* erect, 8–16 cm. long, much surpassing the leaf; *racemes* loosely 12–25-flowered, the flowers early nodding, the axis 5–10 cm. long in fruit; *bracts* lanceolate or filiform, 2–3 mm. long, thinly black-hairy; *pedicels* at anthesis scarcely 1 mm. long, thickened, abruptly dejected, and 2–5 mm. long in fruit; *bracteoles* 0; *calyx* 5–5.5 mm. long, strigulose with mostly dark hairs, the campanulate tube 2.8–3.5 mm. long, ± 2.7 mm. in diameter, the lance-subulate teeth 1.5–2.8 mm. long, becoming papery, marcescent unruptured; *petals* apparently ochroleucous; *banner* recurved through ± 45°, obovate-cuneate, 10.5–11 mm. long, 4.5–5 mm. wide; *wings* 10–10.5 mm. long, the claws 4–4.5 mm., the narrowly oblong, obtuse, slightly incurved blades 6–7.5 mm. long, 1.8 mm. wide; *keel* 8.5 mm. long, the claws 4 mm., the half-obovate blades 4.8 mm. long, 2.3 mm. wide, incurved through 90° to the bluntly deltoid apex; *anthers* 0.45 mm. long; *pod* pendulous, stipitate, the stipe 3–4 mm. long, the narrowly oblong-ellipsoid to narrowly oblong-clavate, nearly straight or slightly decurved body 2–3.8 cm. long, 6–7 mm. in diameter, tapering at base into the stipe, cuneately contracted and cuspidate at apex, obcompressed, rounded ventrally, flattened or openly and shallowly sulcate dorsally, the thin, glabrous valves becoming stramineous, papery, inflexed as an incomplete septum less than 1 mm. wide; *dehiscence* unknown; *ovules* 22–24; *seeds* dark brown, smooth, ± 1.8 mm. long.—Collections: 1 (the typus).

Cool slopes, probably in oak-forest, known only from Sierra Tequila, Jalisco. —Map No. 8.—June to August, probably later.

ASTRAGALUS JALISCENSIS (Rydb.), comb. nov., based on *Atelophragma jaliscense* (of Jalisco) Rydb. in Bull. Torr. Club 55: 157. 1928.—"JALISCO: . . . Sierra Tequila . . . July 5, 1893, *Pringle 4430* . . ."—Holotypus, NY! isotypi, BM, G, K, ND, NY, OB, P, US!

The description of the Jalisco milk-vetch has been drawn from examples of the type-series from Sierra Tequila, the only specimens seen. A collection from the Sierra Madre Oriental near Monterrey *(Pringle 2887)* referred here by Rydberg represents a distinct but related species differing in its shorter stipe and narrower, incurved pod enclosing 10–14, not 22–24 ovules or seeds; it is described below as *A. regiomontanus.* The Jalisco milk-vetch seems to be most closely related to *A. zacatecanus,* differing from that species in its fewer, somewhat larger flowers and more numerous leaflets. A fourth member of the group of elongate-fruiting *Strigulosi,* all of which seem to be highly localized, is *A. Pennellianus,* more easily recognized by its subvillosulous vesture and very numerous small leaflets.

21. ASTRAGALUS REGIOMONTANUS

Tall, leafy, caulescent, presumably perennial but the root not seen, thinly strigulose with subappressed hairs up to 0.35 mm. long, the stramineous, striate stems nearly glabrous from the middle downward, the thin-textured leaflets bicolored, pallid and pubescent beneath, darker green and glabrous above; *stems* well over 4 dm., according to one collector up to 12 dm. long, branched distally, the stouter branches again branched; *stipules* submembranous, the lowest not seen, the median and upper ones deltoid-acuminate or -caudate, 2–4 mm. long, not more than semiamplexicaul-decurrent, the narrow blades mostly reflexed; *leaves* subsessile, 3.5–11 cm. long, with (9) 15–23 ovate or oblong, emarginate, flat leaflets (5) 7–18 mm. long; *peduncles* 2–5 cm. long, much shorter than the subtending leaf; *racemes* loosely (7) 10–15-flowered, the flowers at full anthesis declined, the

axis somewhat elongating, 2–5.5 cm. long in fruit; *bracts* submembranous, pallid, ovate-lanceolate, 1.5–2 mm. long; *pedicels* at anthesis 1.2–1.6 mm. long, in fruit thickened, arched outward, 2–2.5 mm. long, persistent; *bracteoles* 2, minute; *calyx* 5.5–6.1 mm. long, thinly white-strigulose, the oblique disc 0.8–1.1 mm. deep, the campanulate tube 3.4–3.8 mm. long, 2.7–2.9 mm. in diameter, the subulate teeth 2.7–2.9 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous; *banner* recurved through ± 45°, rhombic-obovate or -oblanceolate, openly notched, 1.5–11 mm. long, 4.8–5.5 mm. wide; *wings* about 10 mm. long, the claws 3.5–3.8 mm., the narrowly elliptic-oblanceolate, obtuse or erose-emarginate, scarcely incurved blades 7–7.6 mm. long, 1.4–2.1 mm. wide; *keel* 7.4–7.8 mm. long, the claws 3.4–3.8 mm., the half-obovate blades 4.4–4.7 mm. long, 2.2–2.4 mm. wide, incurved through 85–95° to the rounded or bluntly deltoid apex; *anthers* 0.4 mm. long; *pod* declined, stipitate, the stout stipe 1.5–2 mm. long (mostly concealed by the calyx), the body narrowly oblong-ellipsoid, slightly incurved, (1.9) 2.2–2.6 cm. long, 4–4.5 mm. in diameter, obcompressed-trigonous with very obtuse lateral angles, bluntly carinate ventrally by the suture, openly and widely sulcate dorsally, the thinly fleshy, green, glabrous valves becoming stiffly papery, stramineous, prominently reticulate, inflexed as a broad but not quite complete septum 1.5–1.8 mm. wide; *ovules* 10–14; *dehiscence* apical and downward through the ventral suture, the walls of the septum also separating in age; *seeds* brown, smooth, sublustrous, about 2.8 mm. long.—Collections: 2 (o); representative: *C. H. & M. T. Mueller 492* (AAH).

Habitat not recorded, but to be sought in xeric oak or oak and pine forest, known only from the Sierra Madre near Monterrey, Nuevo León.—Map No. 8.—July to September.

ASTRAGALUS REGIOMONTANUS (of Monterrey), sp. nov., hinc *A. jaliscensi* illinc *A. Pennelliano* affinis, ab eo racemis brevibus cum pedunculo folio suffulcranti superatis, ovulisque paucis (10–14 nec 22–24), ab hoc foliolis multo majoribus atque minus numerosis pubeque sparsa appressa, ab ambobus legumine breviter stipitato lunatim incurvo distincta. Caules elati ut videtur 4–12 usque dm. longi supra medium ramosi; *racemi* (7)10–15-flori, axi fructifero 2–5.5 cm. pedunculo subaequilongo; *flores* ochroleuci, vexillo 10.5–11 mm., carina circa 7.5 mm. longis; *legumen* pendulum anguste oblongo-ellipsoideum 1.9–2.6 mm. longum lunatim incurvum, basi in stipitem crassum 1.5–2 mm. longum angustatum, obtuse trigono-compressum, dorso aperte sulcatum, subbiloculare, glabrum, 10–14-ovulatum.—NUEVO LEON: Sierra Madre near Monterrey, 22 August, 1889, *C. G. Pringle 2887*.—Holotypus, US! isotypus, GH!

The type-collection of the Monterrey milk-vetch, *A. regiomontanus,* was examined by Rydberg but was mistaken by him for *Atelophragma jaliscense,* a species still known only from a point in Jalisco over 350 miles to the southwest of Monterrey. These two astragali are alike, to be sure, in vesture, in number of leaflets, and in the pod of long, narrow outline, but they are very different in other ways. Immediately striking features of *A. regiomontanus* are the short racemes borne on peduncles much shorter than the leaves and the lunate, inward curvature of the pod; but the shortness of the stipe and the few ovules are more important differential characters. The Monterrey milk-vetch is also related to *A. zacatecanus,* from which it differs in fewer flowers and fewer ovules, and to *A. Pennellianus* of Durango, a species with comparatively few ovules but much more numerous and smaller leaflets, more loosely and densely pubescent stems, and a straight pod borne on a much longer stipe. The short stipe of *A. regiomontanus* recalls *A. tioides* of San Luis Potosí, but this has only 3–5 flowers to the raceme and a longer, straight, many-ovulate legume. The material of *A. regiomontanus* now available for study lacks the lower parts of the stem, so that the stature and the lower, presumably connate stipules remain to be described. The species seems to be of taller growth than the *Strigulosi* with long, narrow pods mentioned hitherto, the plants reaching, according to Pringle, a height of three to four feet (about 9–12 dm.); the stems of its relatives are not known to exceed 5 dm. in length.

22. ASTRAGALUS PENNELLIANUS

Slender perennial, with forked taproot and knotty root-crown at or just below soil-level, loosely strigulose-villosulous with fine, subappressed, spreading,

and incumbent, partly sinuous hairs up to 0.4–0.7 (0.9) mm. long, the growing tips cinereous or canescent, the herbage greenish when mature, the leaflets glabrous above, densely pubescent along the prominent midrib beneath; *stems* weakly ascending or spreading, 6–40 cm. long, either simple or spurred at 1–2 nodes preceding the first peduncle, floriferous from 2–4 nodes upward from near or above the middle; *stipules* all fully amplexicaul and connate, but somewhat dimorphic, the lowermost 1–2.5 mm. long, papery, glabrous, united into a shortly bidentate sheath, the rest longer and narrower, herbaceous, up to 4–6.5 (7.5) mm. long, densely pubescent dorsally, the sheath cleft halfway into lanceolate, ascending free blades; *leaves* (2) 3–7.5 cm. long, all but the lowest subsessile, with slender rachis and (17) 25–41 (47) opposite or largely scattered, ovate, obovate, or broadly oblong-elliptic, widely and openly retuse, flat leaflets (1) 1.5–5 mm. long; *peduncles* slender, erect or divergent, 4.5–9 cm. long, equaling or shorter than the leaf, or the most vigorous ones surpassing it; *racemes* loosely (7) 10–25-flowered, the flowers declined in age, the axis ± elongating, (2) 3–4 cm. long in fruit; *bracts* submembranous, pallid or purplish, oblanceolate or lanceolate, 2–4 mm. long; *pedicels* at first ascending, 0.6–1.1 mm. long, in fruit either ascending or variably arched out- and downward, thickened, 1–2.1 mm. long; *bracteoles* 0; *calyx* 4.9–6 mm. long, villosulous with white, or fuscous and some longer white hairs, the scarcely oblique disc 0.8–0.9 mm. deep, the tube 2.9–3.8 mm. long, 2–2.7 mm. in diameter, the broadly lance-subulate teeth 1.7–2.5 mm. long, the whole becoming papery, marcescent unruptured; *petals* creamy-white or pale purple; *banner* gently recurved through ±40°, elliptic-obovate, openly notched, 8–9.3 mm. long, 4–5 mm. wide; *wings* as long or nearly so, 7.5–9.6 mm. long, the claws 3–3.7 mm., the elliptic-oblanceolate, obtuse or obscurely erose-emarginate, slightly incurved blades 5.5–6.5 mm. long, 1.8–2.2 mm. wide; *keel* 6.1–7 mm. long, the claws 3–3.5 mm., the half-obovate blades 3.3–3.9 mm. long, 2–2.3 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid apex; *anthers* 0.4–0.6 mm. long; *pod* loosely pendulous, stipitate, the slender stipe 3.5–7 mm. long, the body narrowly oblong- or lance-elliptic in dorsiventral view, 1.6–2.8 cm. long, 4.5–6 mm. in diameter, straight or a trifle decurved, tapering downward into the stipe, cuneately contracted into the cuspidate apex, strongly obcompressed, obtusely carinate ventrally by the suture, widely and openly sulcate dorsally, the thin, green or often purplish, glabrous valves becoming papery, delicately cross-reticulate, inflexed as a complete or nearly complete septum ± 1 mm. wide; *dehiscence* unknown; *ovules* 10–14; *seeds* purplish-brown, smooth, ± 2–2.2 mm. long.—Collections: 3 (o); representative: *Pennell 18,399* (NY); *Waterfall 15,488* (NY).

Open rocky woodland of oak, pine, and arbutus, 9300–10,300 feet, locally plentiful in the Sierra Madre Occidental in Durango.—Map No. 8.—July to September.

ASTRAGALUS PENNELLIANUS (Francis Whittier Pennell, 1886–1952, eminent student of *Scrophulariaceae*), sp. nov., inter *Strigulosos* legumine elongato anguste ellipsoideo donatos pube laxa hirsutula, foliolisque parvis valde numerosis (saepissime 25–41) insignis.—Caules graciles 6–40 cm. longi; *racemi* (7) 10–20 (25)-flori; *flores* parvuli vexillo 8–9.3 mm. longo, petalis ochroleucis vel lilacinis; *legumen* pendulum, anguste oblongo-ellipsoideum, praeter stipitem gracilem 3.5–7 mm. longum 1.6–2.8 cm. longum, obcompressum, dorso aperte sulcatum, subbiloculare, 10–14-ovulatum, glabrum.—DURANGO: e. slopes of Cerro Prieto, about 20 miles airline w. of Otinapa, July 10, 1950, *James H. Maysilles 7354*.—Holotypus, MICH! isotypi, NY, RSA!

The slenderly oblong-ellipsoid, glabrous pod of the Pennell milk-vetch is similar to that of *A. jaliscensis* and *A. zacatecanus* in all respects except that the stipe is, on the average, longer and the ovules significantly fewer. The species resembles *A. jaliscensis* the more closely in number of flowers to the raceme, although the fruiting axis is shorter and the flowers them-

selves somewhat smaller. The plants are easily recognized otherwise by the loose, hirsutulous pubescence, and especially by the very numerous and small leaflets diminishing in size upward along the rachis. The flowers apparently vary in color, for Maysilles recorded the petals on the Cerro Prieto as "cream or white," whereas Pennell, who first discovered the species in 1934, at Metates, north of Cueva, close to the type-locality, found them "light violet-purple."

23. Astragalus tioides

Slender, caulescent perennial, with an apparently buried root-crown (the root unknown), thinly strigulose-pilosulous with rather stiff, straight, appressed, and sometimes a few narrowly ascending hairs up to 0.55–0.8 mm. long, the herbage green, the leaflets bicolored, yellowish-green and glabrous above; *stems* decumbent and ascending, 2–5 dm. long, simple or spurred at 3–5 nodes preceding the first peduncle, floriferous from well above the middle; *stipules* 2–5.5 mm. long, all connate-amplexicaul, the lowest united into a short, papery, bidentate sheath, the upper ones larger, submembranous, united through half their length or less, with broadly lanceolate or deltoid-acuminate, commonly reflexed blades; *leaves* (3) 4–8 cm. long, the lowest shortly petioled, the rest subsessile, with (7) 13–21 oblong-obovate or obovate, truncate-emarginate or commonly retuse, sometimes obcordate, flat leaflets (2.5) 4–12 mm. long; *peduncles* erect or narrowly ascending, (3.5) 5–10 cm. long, either longer or shorter than the leaf; racemes loosely but shortly 2–5-flowered, the flowers spreading at full anthesis, declined shortly after, the axis little elongating, 0.5–2.5 (3) cm. long in fruit; *bracts* membranous, pallid, lanceolate, 2–3 mm. long; *pedicels* at anthesis ascending or a little arched outward, 1–2 mm. long, in fruit thickened, strongly arched, 2–3.5 mm. long, persistent; *bracteoles* 2, minute; *calyx* 5.3–6 mm. long, pilosulous with narrowly ascending, black and white hairs, the subsymmetric disc 0.8–0.9 mm. deep, the campanulate tube 3–3.3 mm. long, 2.3–2.7 mm. in diameter, the lance-subulate teeth 2.3–2.7 mm. long; *petals* purplish; *banner* gently recurved through 45°, obovate-cuneate or broadly lanceolate, 11 mm. long, 5–6 mm. wide; *wings* 8.9–9.1 mm. long, the claws 3.6–3.9 mm., the narrowly oblong or oblong-oblanceolate, truncate-erose or emarginate, nearly straight blades 6.2–6.5 mm. long, 1.9–2.1 mm. wide; *keel* 7.1 mm. long, the claws 3.8–4.1 mm., the half-obovate blades 3.5–3.9 mm. long, 1.9–2.2 mm. wide, abruptly incurved through 95–100° to the rounded apex; *anthers* 0.35–0.4 mm. long; *pod* declined or pendulous, shortly stipitate, the stipe 1–2 mm. long (concealed by the marcescent calyx), the body linear-oblong in outline, straight or very slightly and gently incurved, 2–3.5 cm. long, (3) 4–6 mm. in diameter, cuneately contracted at both ends, dorsiventrally compressed, obtusely carinate ventrally by the suture, openly sulcate dorsally, the slightly fleshy, glabrous valves becoming rather stiffly papery, stramineous and ultimately blackish, cross-reticulate, inflexed as a nearly complete septum 0.6–1 mm. wide; *dehiscence* apical and through the dorsal suture, the walls of the septum separating in age; *ovules* 18–22; *seeds* brown, smooth, 2.5–2.6 mm. long—Collections: 2 (o); representative: *Parry & Palmer 176* (GH, MO, K, NY, P, US).

Habitat not recorded, but to be sought in open oak or pine forest; known only from the neighborhood of San Luis Potosí.—Map No. 7—Probably flowering after midsummer, dependent on rain.

Astragalus tioides (Rydb.), comb. nov., based on *Atelophragma tioides* (resembling some species of *Tium*) Rydb. in Bull. Torr. Club 55: 157. 1928.—"San Luis Potosi: Valley of San Luis Potosí, in 1876, *Schaffner 822* (type in Gray Herb.), *617*; *Parry & Palmer 176*."—Holotypus, GH! isotypi, variously numbered *822*, *617*, or *617/822*, doubtless all parts of one collection, BM, CAS, K, NY, P, US!

The Schaffner milk-vetch, *A. tioides*, is strongly characterized by its racemes of only two to five loosely arranged flowers, and by the long, narrow pod contracted at base into a stipe

so short as to be concealed by the marcescent calyx and therefore easily overlooked. In other respects it resembles and is doubtless related to *A. jaliscensis,* from which it differs further in its fewer leaflets and slightly shorter, evidently purplish flowers. The species was originally distributed as *A. leptocarpus,* an entirely different Texan annual, and was so listed by Hemsley (1880, p. 265) and by Watson (in Proc. Amer. Acad. 17: 343), who was probably responsible for the misidentification.

The two known collections of *A. tioides* date back to the 1870's; since then the species has apparently escaped the notice of botanists. Material showing the root and the position of the root-crown and caudex, together with information on the color of the fresh petals, and on habitat and environment, is greatly needed.

24. Astragalus altus

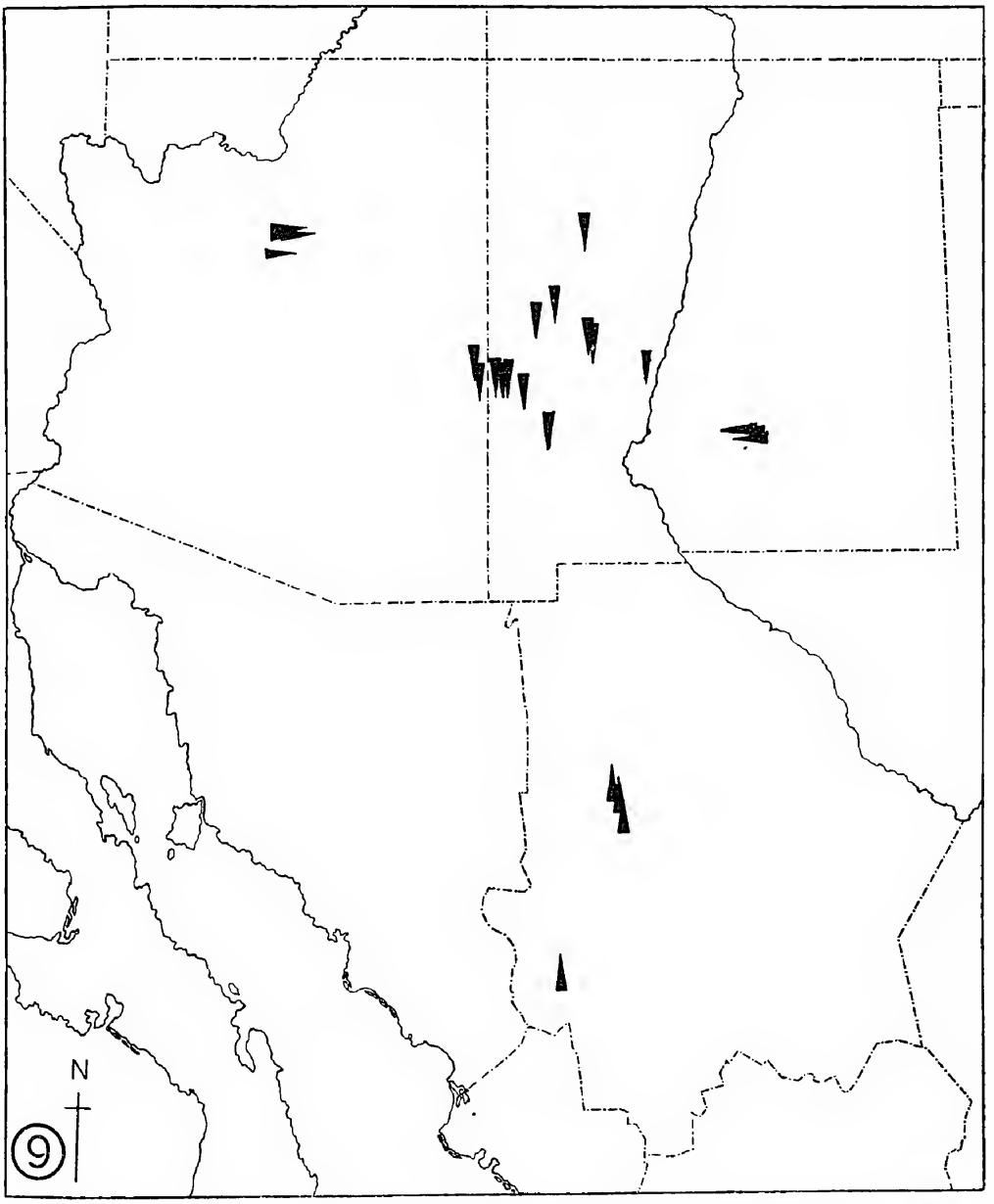
Tall but slender, presumably perennial but the root unknown, the herbage strigulose with fine, straight, appressed or subappressed hairs up to 0.3–0.5 mm. long, the leaflets bicolored, pale green and pubescent beneath, deeper green and glabrous above; *stems* (reportedly several) erect or stiffly ascending, 5–6.5 dm. long, naked, glabrous, purplish at base, freely branching upward from well below the middle (at about 7–9 nodes preceding the first peduncle), the stiffly ascending branches all floriferous and sometimes again branched or spurred; *stipules* submembranous early becoming papery-scarious, 2.5–6 mm. long, dimorphic, the lowest largest, connate into a closely amplexicaul, bidentate, at length fragile and irregularly ruptured or circumscissile sheath, the median and upper ones progressively narrower, lanceolate or triangular-acuminate, very briefly connate at base or semiamplexicaul and free; *leaves* (2.5) 3.5–10 cm. long, the lowest shortly petioled, the rest subsessile, with (13) 15–25 ovate to lance- or oblong-elliptic, obtuse and mucronulate or submarginate, flat leaflets (2) 3–12 mm. long; *peduncles* erect or incurved-ascending, 3.5–6 cm. long, a little longer or shorter than the leaf; *racemes* at first rather closely, at length loosely (15) 20–45-flowered, the flowers nodding, the axis a little elongating, 2.5–6.5 cm. long in fruit; *bracts* membranous, narrowly ovate to lance-acuminate, 1.2–2.5 mm. long; *pedicels* ascending, at length arched outward or in age straight and spreading, at anthesis 1–1.3 mm., in fruit scarcely thickened, 1.2–1.5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 4.3–5.1 mm. long, thinly strigulose with black or mixed black and white hairs, the oblique disc 0.9–1.5 mm. deep, the pallid, campanulate tube 3.3–4 mm. long, 2.4–2.8 mm. in diameter, the triangular-subulate teeth 0.8–1.3 mm. long, the ventral pair commonly much shorter and often broader than the rest, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* apparently ochroleucous, described as "bright yellow"; *banner* gently recurved through 45–50°, rhombic-elliptic or oblanceolate, shallowly notched, 9.6–10 mm. long, 3.4–4.8 mm. wide; *wings* 8.7–9.7 mm. long, the claws 3.5–4 mm., the narrowly elliptic or lance-elliptic, obtuse or erose, gently incurved blades 6–6.4 mm. long, 1.8–2.4 mm. wide; *keel* 6.4–7.6 mm. long, the claws 3–4 mm., the half-obovate blades 3.7–4.2 mm. long, 1.9–2.3 mm. wide, abruptly incurved through 90° to the bluntly deltoid apex; *anthers* 0.4–0.5 mm. long; *pod* pendulous, stipitate, the straight, slender, glabrous stipe 5–6 (or, ex char. "8–10") mm. long, the body obliquely half-oblance-ellipsoid, about 1.5 cm. long and 4.5 mm. in diameter, slightly incurved, cuneate at base, abruptly contracted at apex into a minute cusp, laterally compressed and bluntly trigonous, carinate ventrally by the prominent suture, shallowly and openly sulcate dorsally, the thinly papery valves sparsely strigulose with black or white and a few intermingled black hairs, inflexed as a hyaline septum 0.4 mm. wide; *ovules* 6–10; *dehiscence* and *seeds* unknown.—Collections: 3 (o); representative: *Wooton* (from Tularosa Creek) *in 1901* (NMC); *Wooton* (topotypi) *in July, 1899* (ARIZ, DS, RM).

Openings in yellow pine forest, 6500–7800 feet, local and apparently rare,

known only from the White and Sacramento Mountains, Otero County, New Mexico.—Map No. 9.—July to September.

ASTRAGALUS ALTUS (tall) Woot. & Standl. in Contrib. U. S. Nat. Herb. 16: 136. 1913.—"Type in the U.S. National Herbarium No. 690253, collected at Toboggan in the Sacramento Mountains, Otero County, July 31, 1899, by E. O. Wooton."—Holotypus, US! isotypus, NMC! —*Atelophragma altum* (Woot. & Standl.) Rydb. in Bull. Torr. Club 55: 161. 1928.

The tall milk-vetch, *A. altus,* is related to the Mexican *Strigulosi* described up to this point, although not in particular to any one species. The flower is like that of *A. strigulosus* in its moderately curved banner and wings, but the pod differs in its marked lateral compression,



Map No. 9. Arizona, New Mexico, and northern Mexico. Range of ◗ *A. Rusbyi*; ◓ *A. longissimus*; ◒ *A. Egglestonii*; and ◖ *A. altus*.

vestigial septum, and few ovules. The pod is similar to that of *A. Rusbyi,* the species with which *A. altus* was originally compared; but the flowers of the latter are smaller and more loosely racemose, the petals more strongly incurved and little or irregularly graduated. As interpreted by Wooton & Standley, *A. Rusbyi* included a large element of *A. Egglestonii,* a species not then described, which differs further from *A. altus* in its short stipe, glabrous pod-walls, and broad septum.

The tall, slender, and graceful stems of *A. altus* are freely branched in a paniculate fashion unusual in the genus. The flowers were described as bright yellow, but in the dry state are hardly yellower than many astragalus flowers which are ochroleucous when fresh. The color, as well as the nature of the root and caudex, needs investigation in the field. The species is apparently quite uncommon and has eluded my search on several occasions. Toboggan, the type-locality, was a small settlement in the Sacramento Mountains near Cloudcroft, now abandoned, although the name persists in the form of Toboggan Canyon, situated shortly to the south. According to Wooton and Standley (1910, p. 770) Toboggan stood at an elevation 400 meters lower than Cloudcroft.

25. Astragalus hidalgensis

Slender, doubtless perennial (but the root and caudex not seen), strigulose nearly throughout with fine, straight, appressed or subappressed, or narrowly incurved-ascending hairs up to 0.2–0.4 mm. long, the stems commonly stramineous, the herbage green or greenish-cinereous, the leaflets bicolored, brighter or yellowish-green and glabrous above; *stems* apparently diffuse or weakly ascending, up to 3–6.5 dm. long (or probably more), either branched below and shortly spurred at 1 or more nodes preceding the first peduncle, or freely branching upward and the branches then mostly floriferous; *stipules* 0.8–5 mm. long, either all, all but the uppermost, or at least the lowest of the main stems and of the branchlets connate into a papery, bidentate, at length fragile and sometimes ultimately ruptured sheath, the upper ones sometimes only strongly amplexicaul-decurrent but free; *leaves* (1.5) 2–4.5 cm. long, subsessile, with 13–23 oval- or oblong-obovate, truncate-emarginate or retuse, sometimes also mucronulate, flat, slender-petiolulate leaflets 2–8 mm. long; *peduncles* slender, incurved-ascending, about as long or much longer than the leaf; *racemes* loosely or remotely 6–17-flowered, the flowers early declined, the axis elongating, 1.5–12 cm. long in fruit; *bracts* ovate or lanceolate, 0.7–3 mm. long; *pedicels* at first ascending, slender, 0.8–1.5 mm. long, early arched out- and downward, in fruit recurved or divaricate, thickened, 1.2–3 mm. long; *bracteoles* 0; *calyx* 3.4–4.5 mm. long, strigulose with white, fuscous, or mixed white and fuscous hairs, the subsymmetric disc 0.5–0.8 mm. deep, the campanulate tube 2.3–2.7 mm. long, 1.9–2.3 mm. in diameter, the subulate teeth 0.9–1.8 mm. long, the whole becoming papery, marcescent unruptured; *petals* apparently whitish, perhaps sometimes lilac-tinged; *banner* gently recurved through 40–45°, broadly oblanceolate or ovate- to obovate-cuneate, shallowly or deeply notched, 7–7.8 mm. long, 4.1–4.8 mm. wide; *wings* 6.5–6.9 mm. long, the claws 2.1–2.6 mm., the narrowly oblong or oblong-oblanceolate, erose-emarginate or truncate, slightly incurved blades 5–5.6 mm. long, 1.7 mm. wide; *keel* 4.9–5.2 mm. long, the claws 2.3–2.5 mm., the half-obovate blades 3–3.3 mm. long, 1.7–1.9 mm. wide, abruptly incurved through 90–100° to the broadly rounded or sharply deltoid apex; *anthers* 0.35–0.45 mm. long; *pod* pendulous, stipitate, the stout stipe 0.7–1.2 mm. long, the body varying from obovate to narrowly clavate- or oblong-elliptic in dorsiventral view, straight or a trifle incurved, 1.2–2.3 cm. long, 4.5–5.5 mm. in diameter, cuneate at both ends or more abruptly contracted at apex, dorsiventrally compressed, obtusely carinate ventrally by the broad ventral suture, widely and shallowly sulcate dorsally, the thin, glabrous (or when young minutely puberulent) valves becoming rather stiffly papery, brownish-stramineous, finely cross-reticulate, inflexed as a complete

or nearly complete septum 1.2–1.5 mm. wide; *dehiscence* unknown; *ovules* 9–18; *seeds* (unripe) ± 2.5 mm. long.

The flower of *A. hidalgensis* resembles on a small scale that of all the *Strigulosi* described so far, the banner being bent backward through only half a right angle, while the wings are symmetrical to each other and only slightly incurved toward the banner. On the other hand the very shortly stipitate pod, especially when of short and plump outline as in var. *hidalgensis* itself, is extraordinarily similar to that of *A. cobrensis,* the similarly small flowers of which are differently formed, with a banner recurved through an abrupt right angle and asymmetric wings, one of them with an almost straight and erect blade, whereas the other is bent inward at junction of blade and claw and folded over the keel. A flower of this kind is characteristic of several *Strigulosi* described in the following pages, and these species, including *A. Rusbyi* and its close kindred, *A. Purpusi* and *A. recurvus,* seem to make a somewhat discrete group. But the conjunction of the same pod with the two types of flower in *A. hidalgensis* and *A. cobrensis* point to a common origin for all.

The species is known only from a quite restricted area in western Hidalgo, but the few collections examined are so disparate in some respects that I feel compelled to recognize two varieties.

Key to the Varieties of A. hidalgensis

1. Racemes loose but relatively short, 6–12-flowered, the axis (0.7) 1–3 cm. long in fruit; *body* of the pod short, broad, ± 13–14 mm. long, 5.5 mm. in diameter; *ovules* 9–10 ..... 25a. var. *hidalgensis*
1. Racemes elongate, distantly 10–17-flowered, the axis 5–12 cm. long in fruit; *body* of the pod longer and relatively narrower, (12) 14–23 mm. long, 4.3–5.5 mm. in diameter; *ovules* 14–18 ..... 25b. var. *protensus*

25a. Astragalus hidalgensis var. hidalgensis

Freely branching upward, the branches mostly floriferous; *peduncles* 3.5–5 cm. long, ± equaling the leaf; *calyx* ± 3.5 mm. long, its tube 2.3–2.5 mm., its teeth subulate, 0.9–1.2 mm. long; otherwise as given in the key.—Collections: 4 (o); representative: *Schnooberger 8131A* (MICH).

Mountain ravines, probably in dry woodland, ± 4500 feet, probably upwards, known only from western Hidalgo, near Zimapán and Sierra de la Mesa.—Map No. 8.—June to August.

Astragalus hidalgensis (Rydb.), comb. nov., based on *Atelophragma hidalgense* (of Hidalgo) Rydb. in Bull. Torr. Club 55: 159. 1928, pro max. parte.—"Hidalgo: Sierra de la Mesa, July 31 and Aug. 1, 1905, *Rose, Painter & Rose 3132 . . .*"—Holotypus *(Rose & al. 9132),* NY! isotypi, GH, US!

Astragalus strigulosus var. *gracilis* (slender) Hemsl., Biol. Centr.-Amer., Bot. 1: 266. 1880. —"South Mexico: Zimapán *(Coulter, 631),* Chiapas *(Ghiesbreght, 590).*"—Holotypus *(Coulter),* K!—The supposed isotypus, labeled, "Zimapan, *Coulter 631,*" at GH is part of *Coulter 632* from Real del Monte and = *A. guatemalensis* var. *Lozani;* there is a mixed collection of these two numbers at K. The Ghiesbreght collection from Chiapas (GH, K) = *A. guatemalensis* var. *guatemalensis.—Atelophragma potosinum* (of San Luis Potosí) Rydb. in Bull. Torr. Club 55: 160. 1928, specifically based on the preceding, although the concept was formed out of elements of two other species, the mistaken isotypus of var. *gracilis* at GH and the holotypus of *A. potosinus* Barneby, q.v.

The Hidalgo milk-vetch is easily recognized among the *Strigulosi* of southern Mexico by its small, loosely racemose flowers and small, very shortly stipitate, glabrous or almost glabrous pod. Although smaller than that of *A. strigulosus,* the fruit is quite similar in outward form; unfortunately we know nothing about the mode of dehiscence. Hemsley described it as a variety of *A. strigulosus,* but expressed doubt as to its status. In the context of the section the very much smaller flower and pod are strong specific characters.

Although var. *hidalgensis* seems to be a very local astragalus, it was one of the first of the Mexican species encountered, owing to its occurrence athwart the ancient highway leading from the Valley of Mexico down to the Gulf seaboard. It was collected by the Spanish botanical commission in the last years of the XVIII century (*Herb. Sessé & Mociño 3756,* MA; presumed duplicate *"ex herb. Pavon.,"* BM); and in the 1820's by Thomas Coulter.

25b. Astragalus hidalgensis var. protensus

Stems sparingly branched below, spurred at one or more nodes preceding the first peduncle, floriferous upward from near or above the middle; *peduncles* 6–9.5 cm. long, greatly surpassing the leaf; *calyx* 4–4.5 mm. long, its tube ± 2.6 mm., its teeth subulate, 1.3–1.8 mm. long; otherwise as given in the key.—Collections: 1 (o).

Mountain ravines, probably in open woodland, ± 4500 feet, known only from Jacala, Hidalgo.—Map No. 8.—June to July, probably later.

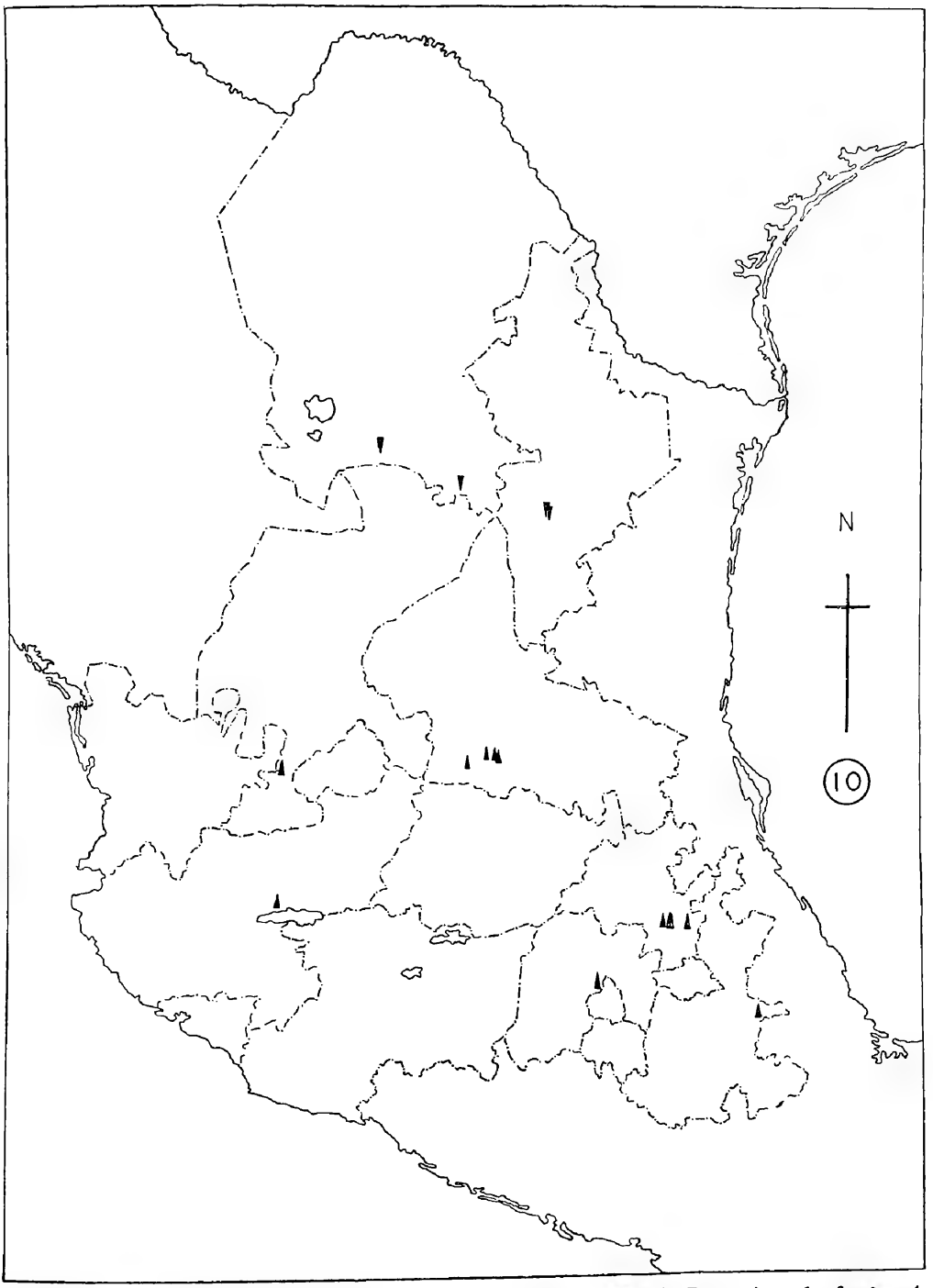
Astragalus hidalgensis var. protensus (drawn out, of the racemes and pods), var. nov., a var. *hidalgensi* pedunculis racemisque elongatis et legumine longiori et angustiori 14–18-ovulato absimilis.—Hidalgo: Jacala, 4500 ft., June 26, 1939, fl. & fr., *Virginius H. Chase 7160*.—Holotypus, NY! isotypi, ARIZ, GH, MICH, MO!

It seems possible but hardly probable that the collection described above as var. *protensus* represents only an aberrant form of *A. hidalgensis*, for it differs so greatly in facies because of the loosening and lengthening of so many organs: stipules, peduncles, axis of the racemes, calyx-teeth, and finally the pod, which is narrowly oblong-ellipsoid rather than obliquely obovoid as in var. *hidalgensis* and contains seven to nine rather than only four or five pairs of ovules. The varieties of the Hidalgo milk-vetch are obviously too little known, and since they are nearly sympatric may prove to run together in nature. Field observation is required to settle their status.

26. Astragalus Purpusi

Low or dwarf, caulescent perennial, with a stout woody taproot and branched, lignescent caudex shallowly buried in soil or litter, rather thinly strigulose with appressed or narrowly ascending hairs up to 0.35–0.7 mm. long, the herbage greenish or subcinereous, the leaflets glabrous above; *stems* diffuse, tufted or matted, the growth of the year 5–20 cm. long, simple or branched toward the base; *stipules* subherbaceous becoming papery-scarious, 1–5 mm. long, connate through ½–⅔ their length into a loose sheath; *leaves* 1.5–5 cm. long, shortly petioled or subsessile, with 13–23 crowded, oblong-obovate to oblanceolate, truncate-retuse, ciliate leaflets 1.5–6 mm. long; *peduncles* very slender, 1.5–4.5 cm. long; *racemes* closely 7–21-flowered, the flowers spreading and at length declined, the axis somewhat elongating, 0.4–1.6 cm. long in fruit; *bracts* membranous, pallid, lanceolate, 1.5–2.3 mm. long; *pedicels* at anthesis ± 0.6–0.8 mm. long, in fruit arched outward, a little thickened, 0.7–1.2 mm. long, tardily disjointing; *bracteoles* 0; *calyx* 2.4–3.6 mm. long, black-or fuscous-strigulose, the subsymmetric disc 0.4–0.5 mm. deep, the campanulate or obconic-campanulate tube 1.5–2.2 mm. long, 1.3–1.6 mm. in diameter, the slenderly or broadly subulate teeth 0.7–1.5 mm. long, the ventral pair commonly shortest, the whole becoming papery, marcescent, ruptured or not; *petals* pale purple, the banner striate; *banner* recurved through ± 45°, ovate-, obovate–, or suborbicular-cuneate, openly notched, 4.5–7.4 mm. long, 3.1–5 mm. wide; *wings* 4.1–5.7 mm. long, the claws 1.5–2 mm., the oblanceolate, narrowly oblong, or narrowly obovate, erose-emarginate or obtuse, slightly (and equally) incurved blades (2.8) 3–4.5 mm. long, 0.9–2 mm. wide; *keel* 3.5–4.3 mm. long, the claws 1.5–2 mm., the obliquely obovate or half-obovate blades 2–2.5 mm. long, 1.3–1.5 mm. wide, incurved through ± 80° to the blunt apex; *anthers* 0.25–0.3 mm. long; *pod* pendulous or declined, subsessile, obliquely ellipsoid or commonly widest above the middle and thus clavately ellipsoid, 5–8 mm. long, 2.2–3.4 mm. in diameter, cuneate or cuneately tapering at base, cuneate or abruptly contracted at apex into a conic cusp ± 1 mm. long, obtusely trigonous and a trifle laterally or dorsiventrally compressed, obtusely carinate ventrally by the convexly arched suture, flattened or shallowly sulcate dorsally, the thin, green, minutely strigulose valves becoming papery, stramineous, deli-

cately cross-reticulate, inflexed as a complete or nearly complete septum 1.5–2.3 mm. wide; *dehiscence* unknown; *ovules* (2) 4–5; *seeds* (not seen ripe) ± 2–2.5 mm. long.—Collections: 7 (o); representative: *C. H. Mueller 932* (NY), *2195* (NY, TEX); *Stanford, Weatherford & Northcraft 417* (GH, NY); *Beaman 3307, 4458* (NY).



Map No. 10. Central and northeastern Mexico. Range of ▼ *A. Purpusi*; and of ▲ *A. esperanzae.*

Alpine meadows and open ground in the pine belt, or with junipers and arbutus, 9000–12,150 feet, apparently rare, known only from the mountains of southern Coahuila (Sierra de Parras; northwest of Fraile) and adjoining Nuevo León (Cerro Potosí, municipio de Galeana).—Map No. 10.—June to September.

ASTRAGALUS PURPUSI (Joseph Anton Purpus, 1860–1932, collected widely and imaginatively in s.-w. U. S. and Mexico) Jones, Contrib. West. Bot. 14: 34. 1912.—"Sierra de Parras, Coahuila, Mexico, July 1910, 9,000 ft. alt. C. A. Purpus."—Holotypus, *Purpus 4582,* POM! isotypi, BM, G, GH, P, US!—*Atelophragma Purpusi* (Jones) Rydb. in Bull. Torr. Club 55: 164. 1928.

The Purpus milk-vetch recalls some mat-forming *Ervoidei* in general habit of growth and is easily recognized in Mexico by its low stature and tiny leaflets combined with very small, densely racemose flowers and obtusely trigonous, few-seeded, fully bilocular pod. In the first instance Jones referred *A. Purpusi* to the "Didymocarpus-Brazoensis group" and described the pod as stipitate and two-seeded. In reality the pod is usually 4–5-ovulate and often two fertile seeds develop in each locule of the fruit; moreover it is not distinctly stipitate but merely narrowly downward into a slenderly cuneate neck. Later Jones (1923, p. 281, Pl. 71) transferred the species to sect. *Micranthi,* a heterogeneous group of which all other members except *A. micranthus* and *A. esperanzae* are characterized by free stipules or deciduous fruits or both. It was placed next to *A. Seatoni* (our *A. micranthus*) in *Atelophragma* by Rydberg (l.c.) and can hardly belong elsewhere in the genus but in our equivalent sect. *Strigulosi.* It is peculiar in the section because of the very wide, complete or nearly complete septum, but the flower is closely similar to that of *A. pueblae* and *A. micranthus,* and the fruit on a small scale to that of *A. cobrensis.* The pod is bluntly trigonous but varies in compression, the cross-section being sometimes broader than high and at others higher than broad. In size and outline the pod resembles that of *A. scalaris,* and the flowers are similar in many details. However, the pod of *A. scalaris* is unilocular and the habit of growth and free stipules completely different.

27. ASTRAGALUS PUEBLAE

Very slender, diffuse, tap-rooted perennial, sparingly strigulose with appressed hairs up to 0.3 mm. long, the herbage greenish, the leaflets glabrous above; *stems* subfiliform, flexuous, branching below, sparsely leafy, up to 6 dm. long, floriferous upward from well below the middle; *stipules* triangular, 1–2.5 mm. long, the upper ones semiamplexicaul and free, the lowest probably connate in vernation (as an occasional pair found low on some lateral branchlets); *leaves* 3–7 cm. long, petiolate, with 11–15 distant, linear, obtuse, folded leaflets 4–10 mm. long; *peduncles* very slender, 3–4.5 cm. long; *racemes* very shortly but loosely 7–12-flowered, the flowers spreading, the axis scarcely elongating, 5–10 mm. long in fruit; *bracts* ovate or subulate, 0.7–1.2 mm. long; *pedicels* at anthesis 1–1.5 mm. long, in fruit arched outward, scarcely thickened, 1.8–2.2 mm. long, tardily disjointing with the fruit; *bracetoles* 0; *calyx* 2.5–3 mm. long, strigulose with black and a few pallid hairs, the slightly oblique disc 0.4 mm. deep, the shallowly campanulate tube 1.6–2 mm. long, 1.5–1.8 mm. in diameter, the broadly subulate teeth 0.5–1 mm. long, separated by obtuse sinuses, the whole becoming papery, marcescent unruptured; *petals* pale purple; *banner* recurved through ± 45° (or further in withering), broadly rhombic-ovate, 6 mm. long, 3.2–3.5 mm. wide; *wings* nearly as long, 5–5.9 mm. long, the claws 2–2.4 mm., the oblong, obtuse, little (but equally) incurved blades 4–4.2 mm. long, 1.4–1.6 mm. wide; *keel* 4.1–4.3 mm. long, the claws 2–2.2 mm., the broadly half- or quadrate-obovate blades 2.3–2.5 mm. long, 1.6–1.8 mm. wide, abruptly incurved through 90° to the deltoid apex; *anthers* 0.3 mm. long; *pod* pendulous, subsessile, apparently persistent on the receptacle, oblong-obovoid, 7–8 mm. long, 2–3 mm. in diameter, obtuse at base, minutely apiculate-beaked, obcompressed-triquetrous, with blunt lateral angles, low-carinate ventrally by the suture, openly grooved dorsally, the thin, green, minutely strigulose valves becoming papery, brownish-stramineous, not inflexed; *dehiscence* ap-

parently apical; *ovules* (6) 8–12; *seeds* brown, wrinkled, sublustrous, ± 1.5 mm. long.—Collections: 1 (typus only).

Habitat not recorded, known only from the type locality at Esperanza, in the foothills of the Orizaba massif about 60 miles east-northeast of Ciudad Puebla, Puebla.—Not mapped—August to October.

ASTRAGALUS PUEBLAE (of Puebla) Jones, Contrib. West. Bot. 14: 35. 1912 *("Pueblae").*—"No. 5645 Purpus, Esperanza, Pueblo Mexico, Sept. 1911."—Holotypus, POM! isotypi, BM, GH, NY, UC, US!—*Atelophragma pueblae* (Jones) Rydb. in Bull. Torr. Club 55: 164. 1928.

The Puebla milk-vetch is like no other Mexican astragalus, very easily recognized by its slender, sparsely leafy stems, few, narrow leaflets, subumbellate inflorescence of tiny, purplish flowers, and very small, almost sessile, unilocular fruits. In its exterior form and mode of compression the pod is similar to that of *A. Purpusi* and *A. cobrensis,* but the dissepiment—even though Rydberg ascribes to it "a trace of a septum"—has become essentially obsolete. Because of its nearly sessile fruit Jones (1923, p. 275, Pl. 69) associated *A. pueblae* with the free-stipuled, mostly piptoloboid *Micranthi.* Despite the fact that most of the stipules on the type-series, even at the base of the stems, are free and seem to have been so from the first, I have no doubt that Rydberg was correct in referring *A. pueblae,* together with *A. Purpusi,* to *Atelophragma* rather than *Hamosa.* Moreover I have found a few connate stipules low on some lateral branches in *A. pueblae,* and the lowest of the main stems are very likely united, at least in vernation, opposite the suppressed petiole. Truly ripe fruits are required to demonstrate the mode of fall and dehiscence.

28. ASTRAGALUS RECURVUS

Low, diffuse, rather slender perennial, with a woody, ultimately very stout taproot and shallowly buried, pluricipital root-crown or shortly forking caudex, thinly strigulose with fine, straight, appressed hairs up to 0.3–0.45 mm. long, the herbage green, the leaflets glabrous above; *stems* several or many, decumbent with ascending tips, 1–2 dm. long, leafless and subterranean for a space of 1–4.5 cm., simple or sparingly branched from near the base or at 1–3 nodes preceding the first peduncle; *stipules* 1.5–4 mm. long, membranous becoming papery, often purple-tinged, connate-amplexicaul, the lowest into a bidentate or subtruncate sheath, the median and upper ones united through half their length or less, with triangular, mostly erect blades; *leaves* (1.5) 3–7 cm. long, petioled but the uppermost shortly so, with 9–19 oblong-obovate, elliptic, or linear-oblong, obtuse or emarginate, flat or loosely folded leaflets 2–10 mm. long; *peduncles* mostly incurved-ascending, 3–10 cm. long; *racemes* loosely (5) 7–25-flowered, the flowers at first ascending, then spreading, ultimately declined, the axis 1.5–9 cm. long in fruit; *bracts* membranous, ovate or triangular-lanceolate, 0.5–1.5 mm. long; *pedicels* at anthesis slender, ascending or a trifle curved, 0.5–1.5 mm. long, in fruit somewhat thickened, arched outward, downward, or deflexed, 1–2.4 mm. long, tardily disjointing with the fruit; *bracteoles* 0; *calyx* 3.5–4.7 mm. long, strigulose with white, or with white and black hairs, the subsymmetric disc 0.5–0.9 mm. deep, the campanulate tube 2–3.2 mm. long, 1.8–2 mm. in diameter, the subulate teeth 1–1.6 mm. long, the whole becoming papery, marcescent usually unruptured; *petals* whitish tinged with sordid lilac; *banner* recurved through 65–90°, ovate-cuneate, 5.2–7.7 mm. long, 4–5.8 mm. wide; *wings* nearly as long or a trifle longer, 5.1–8 mm. long, the claws 1.7–2.6 mm., the obliquely elliptic-oblanceolate or triangular-obovate, obtuse blades 3.9–6 mm. long, 1.8–2.7 mm. wide, the left one more strongly incurved than the right; *keel* 5–6.5 mm. long, the claws 1.9–2.7 mm., the crescentic blades 3.5–4.7 mm. long, 1.8–2.3 mm. wide, incurved through 50–95° to the sharply triangular apex; *anthers* 0.4–0.65 mm. long; *pod* pendulous, sessile or nearly so, the stipe when present not over 0.7 mm. long, the body linear-oblong or -elliptic in profile, strongly curved downward, 1.3–2.5 cm. long, 2.3–3 mm. in diameter, cuneate or acuminately tapering at either end, compressed-trique-

trous, keeled ventrally by the prominent suture, the low-convex lateral faces much wider than the narrowly and rather deeply grooved dorsal face, the thin, green, sometimes purplish-tinged, finely strigulose valves becoming papery, stramineous, cross-reticulate, inflexed as a nearly complete septum 0.7–1.5 mm. wide; *dehiscence* through the length of the ventral suture, the walls of the septum also separating in age; *ovules* 12–18; *seeds* brown or olivaceous, rugulose-punctate but somewhat lustrous, 1.9–2.8 mm. long.—Collections: 12 (iv); representative: *Deaver 2475* (CAS); *Ripley & Barneby 8458* (CAS, NY, RSA, UTC); *Barneby 12,648* (CAS, POM, RSA, US), *12,650* (CAS, NY, RSA); *MacDougal 72* (ARIZ, NY).

Open places in forest of yellow pine, mixed oak and pine, or juniper, in dry stony volcanic soils, 4800–7050 feet, locally plentiful but not frequent, Flagstaff Plateau and headwaters of the Verde River, southern Coconino and central Yavapai Counties, southeast to Sierra Ancha and the head of Tonto Creek on the slopes of the Mogollon Escarpment in northwestern Gila County, Arizona.—Map No. 11.—April to early July.

ASTRAGALUS RECURVUS (bent backward, of the decurved pod) Greene in Bull. Calif. Acad. Sci. 1: 157. 1885.—"Mountains of the northern part of Arizona, 1883, Dr. H. H. Rusby."—No typus found at CAS, ND, NY, UC, or US, but possibly overlooked or mislaid, as Rydberg (1931, p. 405) cities "*Rusby in 1883* (type)" and Jones (1895, p. 636) mentioned a type-specimen being "very poor and in fruit only." The holotypus should be at CAS, and was possibly lost at the time of the San Francisco fire.—*Tium recurvum* (Greene) Rydb. in N. Amer. Fl. 24: 397. 1929.

The recurved milk-vetch was appropriately named in reference to its slenderly oblong-ellipsoid pod which is arched downward in a gentle lunate curvature to form in profile the figure of an inverted crescent. The detached fruit is similar in form to that of *A. atratus* with which it was referred by Rydberg (1929, l.c.) to *Tium* sect. *Atrata,* a group remote from *Strigulosi* by reason of its free stipules and differently shaped flowers. The relationship of *A. recurvus* to the present section was appreciated by Jones, although he associated it with *A. straturensis,* another species with free stipules, here referred to sect. *Miselli.* The recurved milk-vetch and *A. straturensis* both have small, loosely racemose flowers; specimens of the latter with immature fruits have been misidentified as *A. recurvus,* giving rise to reports of it from the Grand Canyon (Jones, 1923, p. 186) and southern Utah. Apart from the morphological differences, *A. straturensis* is strongly calciphile, whereas *A. recurvus* is known only from soils derived from the decay of comparatively recent lavas and volcanic cinders.

While mature fruiting material of *A. recurvus* is easily recognized, care should be taken to distinguish younger specimens from the related *A. Rusbyi,* also endemic to basaltic soils in central Arizona, and similar in most technical characters. The latter differs in its slightly more numerous (17–25 rather than 9–19) leaflets in vigorous leaves, and in the wing-petals which very prominently surpass the strongly recurved banner. The recurved milk-vetch begins to flower in April or early May and is commonly in fruit by the end of May or the first week in June, while the earliest flowers of *A. Rusbyi* appear no earlier than mid-June, and fruit cannot be obtained before July. The pod of *A. Rusbyi* is nearly straight and borne on a stipe 2–5 mm. long.

29. ASTRAGALUS RUSBYI

Slender perennial, with a shortly forking caudex at or just below soil-level, thinly strigulose with straight, filiform, appressed or subappressed hairs up to 0.35–0.7 mm. long, the stems glabrous or nearly so toward the base, the herbage green, the leaflets glabrous above; *stems* several, erect and incurved-ascending, 1.5–3.5 (4) dm. long, leafless at base, commonly branched or spurred at 1–4 nodes preceding the first peduncle; *stipules* 1.5–5.5 mm. long, dimorphic, those at the lowest nodes commonly the smallest, papery-membranous, amplexicaul and connate into a cuplike, subentire or obtusely bidentate sheath, the median and upper ones decurrent around about half the stem's circumference, or some of them united by a low collar or stipular line; *leaves* (2.5) 3–8 cm. long, all but the lowest

subsessile, with (11) 17–25 oval-oblong, oblanceolate, narrowly obovate, ovate, or (in some upper leaves) narrowly oblong-elliptic, obtuse, truncate, or shallowly retuse (and then often apiculate), flat or loosely folded leaflets (3) 4–11 mm. long; *peduncles* erect or incurved-ascending, (2) 4–11 cm. long, the principal ones longer than the leaf; *racemes* very loosely or remotely (10) 15–25-flowered, the flowers early spreading and nodding at full anthesis, the axis elongating, (2.5) 6–18 cm. long in fruit; *bracts* membranous, ovate-acuminate or lanceolate, 1–2.5 mm. long; *pedicels* at anthesis ascending and abruptly arched outward or hooked at apex, 0.8–1.8 mm. long, in fruit decurved or deflexed, a trifle thickened, (1.5) 2–3.2 mm. long, tardily disjointing with the fruit; *bracteoles* 0, rarely a minute scale; *calyx* 3.2–4.1 mm. long, loosely strigulose with black, fuscous, or largely white hairs, the subsymmetric disc 0.5–0.8 (1) mm. deep, the campanulate tube 2.1–2.6 mm. long, 1.8–2.3 mm. in diameter, the subulate or triangular-subulate teeth 0.8–1.6 mm. long, the whole becoming papery, marcescent unruptured; *petals* whitish, sometimes tinged with lavender; *banner* abruptly recurved through ± 90°, ovate-cuneate, shallowly notched or subentire, 6.3–7.2 mm. long, 3.5–4.5 mm. wide; *wings* 0.2–0.9 mm. longer than the banner, 6.9–8 mm. long, the claws 2.2–2.7 mm., the linear- or lance-oblong, or linear-elliptic, obtuse or bidentate blades 5–5.8 mm. long, 1.2–2 mm. wide, both incurved but the left one more abruptly and further than the right; *keel* 4.6–5.5 mm. long, the claws 2.1–2.6 mm., the half-orbicular or obtusely triangular blades 2.9–3.3 mm. long, 1.5–2 mm. wide, abruptly incurved through 100° to the blunt apex; *anthers* 0.3–0.4 mm. long; *pod* pendulous, stipitate, the straight, slender stipe 2.2–5 mm. long, the body linear-oblong or -ellipsoid, 1.3–2.2 cm. long, 3.2–4.1 mm. in diameter, straight or obscurely decurved, cuneate or cuneately attenuate at base, shortly cuspidate at apex, obscurely trigonous, with low-convex lateral and flattened or shallowly and openly sulcate dorsal faces, the thin, pale green valves minutely strigulose with black or mixed black and white hairs, becoming papery, stramineous, inflexed as a nearly complete septum 0.8–1.5 mm. wide; *dehiscence* apical and downward through the ventral suture; *ovules* 7–13; *seeds* not seen ripe.—Collections: 12 (i); representative: *Jones 3946* (NY, POM); *Schallert* (from Navajo Ordnance Depot) *in 1943* (CAS, NY); *MacDougal 233* (NY); *Bacigalupi 551* (DS).

Meadows in yellow pine forest, or at the edge of thickets and aspen groves, in dry or temporarily moist basaltic soils, mostly 7000–8000 feet, local but forming colonies, Flagstaff Plateau and foothills of the San Francisco Peaks, descending along Oak Creek to 5400 feet, Coconino and perhaps immediately adjoining Yavapai County, Arizona.—Map No. 9.—June to September.

ASTRAGALUS RUSBYI (Henry Hurd Rusby, 1855–1940, botanist, physician, collector of medicinal plants, organizer of the Herbarium of N. Y. College of Pharmacy, now at NY) Greene in Bull. Calif. Acad. Sci. 1: 8. 1884.—"On Mt. Humphreys, in the northern part of Arizona, collected July 2, 1883, by Mr. H. H. Rusby."—Holotypus, *Rusby 573*, CAS! isotypi, ND, NY, ORE, PH, US, WS!—*Atelophragma Rusbyi* (Greene) Rydb. in Bull. Torr. Club 55: 162. 1928.

The Rusby milk-vetch and the two species next in order, *A. Egglestonii* and *A. longissimus*, are closely related, sharing all important technical features and a common general facies. They are rather tall, slender plants of xeric pine forest, with small, loosely or remotely and somewhat virgately racemose flowers giving rise to pendulous, stipitate, almost fully bilocular pods of linear-oblong outline and more or less trigonous compression. Like most *Strigulosi* they flower from midsummer onward into the fall months and vary in vigor and abundance in proportion to the amount and timing of the summer rains. These three astragali differ from each other in relatively minor characters of vesture, length of stipe, and number of leaflets; they might almost as well be interpreted as varieties of a collective species. Each, however, is apparently confined to a small, well-defined, disjunct and eminently natural area of dispersal, and there is no hint of intermediate populations. The trio of species was treated by Jones (1923, p. 186–7,

Pl. 42. 77) as comprising a large part of *A. strigulosus* sensu Jones (non H. B. K.), an ambiguously comprehensive and obviously misnamed concept which included *A. altus* and probably *A. hidalgensis* or some other central Mexican forms. It is clear from Jones's synonymy and figures that his typical *A. strigulosus* is equivalent approximately to our *A. longissimus*; his (but not Hemsley's) var. *brevidentatus* is essentially *A. Rusbyi* with a small, misplaced element of *A. altus;* while his (but not Hemsley's) var. *gracilis,* supposedly "less pubescent" and "the common form northward," was probably our *A. Egglestonii.* The last mentioned was described by Rydberg as a species of *Tium,* implying a pod of thicker texture than in related species which he referred to *Atelophragma*; but there is no real difference in this respect.

Although much further removed geographically from *A. longissimus,* in Chihuahua, than from *A. Egglestonii* which enters eastcentral Arizona from New Mexico, the Rusby milk-vetch resembles the Mexican species the more closely, differing in its greener, thinly pubescent herbage, fewer leaflets, and rather more slender pod. The pod of *A. Egglestonii* differs in being hairless and borne on a shorter stipe only 1.5–2.5 mm. long.

30. Astragalus longissimus

Perennial from a woody taproot and knotty root-crown or shortly forked caudex at or just below soil-level, pilosulous with fine, subappressed and narrowly ascending, straight or nearly straight hairs up to 0.6–1 mm. long, the herbage green or subcinereous, the leaflets glabrous, medially glabrescent, or strigulose above; *stems* few, rather stout, erect or strictly ascending, (1.5) 2–4 dm. long, simple or branched or spurred at 1–3 nodes preceding the first peduncle, floriferous upward from near or shortly above the middle; *stipules* 1.5–8 mm. long, dimorphic, the small lower ones amplexicaul and connate into a papery, bidentate sheath, becoming fragile and sometimes deciduous in age, the upper ones herbaceous, lanceolate, very shortly or obscurely connate or free; *leaves* 5.5–15 cm. long, subsessile or the lowest shortly petioled, with 25-39 (45) oblanceolate to narrowly obovate, elliptic, or linear-elliptic, obtuse or mucronulate, mostly flat leaflets (1) 3–14 mm., long; *peduncles* erect or incurved-ascending, 5–21 cm. long, the first 1–3 usually stout, the later ones slender, equaling or longer than the leaf; *racemes* loosely or remotely (12) 20–45 (75)-flowered, the flowers early reflexed, the axis elongating, (4) 6–15 (30) cm. long in fruit; *bracts* linear-lanceolate, 1.5–3 mm. long; *pedicels* at anthesis 1–2 mm. long, becoming recurved, abruptly deflexed, or straight and declined or divaricate, somewhat thickened, 2–4 mm. long in fruit, persistent; *bracteoles* 0; *calyx* 3.2–5 mm. long, densely strigose-pilosulous with white, fuscous, black, or mixed light and dark hairs, the somewhat oblique disc 0.7–1 mm. deep, the tube 2.4–3.5 mm. long, 2.1–3 mm. in diameter, the subulate or triangular-subulate teeth 0.8–1.5 mm. long, the ventral pair sometimes shortest and broadest, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, drying dull yellow; *banner* recurved through ± 50° or further in withering, ovate-cuneate, shallowly notched, 5.3–8.3 mm. long, 3.2–5.5 mm. wide; *wings* (0.1–1 mm. longer) 5.4–8.5 mm. long, the claws 2–3.5 mm., the obovate or narrowly oblong, obtuse or truncate-emarginate blades 3.7–5.5 mm. long, 1.5–2.5 mm. wide, both incurved but the left one more abruptly so from its junction with the claw; *keel* 4.5–6.6 mm. long, the claws 2.1–2.8 mm., the half-obovate or -orbicular blades 2.8–4 mm. long, 1.7–2.5 mm. wide, incurved through 95–105° to the deltoid, often subporrect apex; *anthers* 0.4–0.5 mm. long; *pod* pendulous, stipitate, the straight stipe 3–5.5 mm. long, the body narrowly lance-oblong, oblong, or oblong-elliptic in profile, straight or very slightly decurved, 1.4–2.3 cm. long, 4–5 mm. in diameter, cuneate at both ends, obcompressed-triquetrous, carinate ventrally by the prominent thick suture, openly and shallowly sulcate dorsally, the lateral faces low-convex, the lateral angles obtuse, the green, scarcely fleshy valves becoming stramineous, rather stiffly papery, faintly reticulate, inflexed as a partial or subcomplete septum 0.7–1.3 mm. wide; *ovules* 10–20; *seeds* pale or purplish-brown,

pitted and sometimes prismatically angled, scarcely lustrous, 2–2.5 mm. long.—Collections: 8 (o); representative: *E. W. Nelson 6174* (NY, US), *6283* (NY); *Jones* (from Mound Valley) *in 1903* (NY, POM, US).

Stony meadows and grassy stream banks in open oak and pine forest, about 7000–7600 feet, apparently not uncommon on the east slope of the Sierra Madre in westcentral Chihuahua.—Map No. 9.—July to September.

ASTRAGALUS LONGISSIMUS (Jones), comb. nov., based on *A. Rusbyi* var. *longissimus* (very long, of the stipe) Jones in Proc. Calif. Acad. Sci. II, 5: 662. 1895.—"Type specimen in the National Herbarium. Dr. Palmer, Chihuahua, Mexico, 1885; Pringle same, by streams in the Sierra Madre Mountains, September 23. No. 1219."—Holotypus, US! paratypi *(Pringle 1219)*, ND, NY, US!—*Atelophragma longissimum* (Jones) Rydb. in Bull. Torr. Club 55: 162. 1928.

Atelophragma Townsendii (Charles Henry Tyler Townsend, b. 1863) Rydb. in Bull. Torr. Club 55: 162. 1928.—"CHIHUAHUA: Sierra Madre, *Townsend & Barber 95* . . ."—Holotypus, collected in the Sierra Madre 10 miles s.-e. of Colonia Garcia, July 27, 1899, NY (2 sheets)! isotypi ARIZ, K, ND, P, POM, US!

The Townsend milk-vetch, *A. longissimus*, is variable in size of the flowers and density of the pubescence, the herbage varying from green to cinereous and the leaflets from quite glabrous to thinly or even densely hairy above. A combination of relatively large flowers with abundant vesture corresponds with Rydberg's concept of *Atelophragma Townsendii*, but collections from near Colonia Garcia other than the typus show that these characters are not correlated but fluctuate independently one of another. The indumentum of the pod, calyx, and raceme-axis may be monochrome and white, black, or fuscous, but a mixture of pale and darker hairs is most commonly met with. The color of the hairs has, as always, no taxonomic significance.

The close relationship between *A. longissimus* and *A. Rusbyi* has been mentioned under the preceding species, from which the present subject differs principally in its longer leaves composed of more numerous pairs of leaflets and in its slightly broader, more densely strigulose pod. It is no longer possible to distinguish the Mexican species by a longer stipe; and even though the ovules are commonly more numerous than in *A. Rusbyi*, enough overlapping counts are recorded to make the character useless in practice. In general *A. longissimus* is a coarser plant, with stiffer and more erect stems. In his Revision (1923, p. 186) Jones interpreted *A. Rusbyi* var. *longissimus* as equivalent (pro parte) to *A. strigulosus* Kunth, but it is now scarcely possible to disentangle or attempt a reasonable interpretation of his nebulous concepts in this group of forms or of the figures (op. cit., Pl. 42) designed to illustrate them.

31. ASTRAGALUS EGGLESTONII

Rather slender but often tall and stiff perennial, with a taproot and shortly forking caudex at or just below soil-level, appearing nearly glabrous, but bearing a few, scattered, straight, appressed hairs up to 0.25–0.45 mm. long on the upper parts, the margins and midribs of the leaflets, the inflorescence thinly black-strigulose; *stems* several, erect and strictly ascending, (1.5) 2–5.5 dm. long, simple or commonly spurred or shortly branched at 1–3 (6) nodes preceding the first peduncle, floriferous from near or above the middle, leafless at base; *stipules* 1.5–5 mm. long, somewhat dimorphic, the small, scarious-papery lower ones connate into a short, bidentate sheath or amplexicaul as a narrow band or collar around the stem (sometimes reduced to a stipular line), the upper ones progressively longer and narrower, deltoid-acuminate or broadly lanceolate, thinly herbaceous, about semiamplexicaul; *leaves* (3) 4–12 cm. long, shortly petioled or the uppermost sessile or subsessile, with (17) 21–29 oblong-oblanceolate or elliptic, obtuse, obtuse and mucronulate, or subacute, flat or loosely folded leaflets 3–13 mm. long, the midrib prominent below; *racemes* loosely, sometimes remotely (5) 10–30-flowered, the flowers early nodding, the axis elongating, (1.5) 3–19 cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–2 mm. long; *pedicels* early spreading or recurved, at anthesis (0.7) 1–1.8 mm. long, in fruit either strongly recurved, or straight and then either divaricate or deflexed, thickened, 2–3.5 mm. long, persistent; *bracteoles* 2, minute, scarious; *calyx* 3.4–4.3 mm. long, strigulose

with black or black and a few white hairs, the oblique disc 0.5–1 mm. deep, the campanulate tube 2.1–2.7 mm. long, 1.6–2.2 mm. in diameter, the subulate teeth 1–2 mm. long, the whole becoming papery, marcescent unruptured; *petals* whitish or dull greenish-ochroleucous, immaculate; *banner* abruptly recurved through 90° (or further in withering), rhombic-ovate or ovate-cuneate, shallowly notched or entire, 5.8–8 mm. long, 4.2–6.4 mm. wide; *wings* (0.2 mm. longer to 0.7 mm. shorter than the banner) 5.8–7.3 mm. long, the claws 1.8–2.4 mm., the lunately oblong, obtuse or obscurely emarginate blades 4.4–5.6 mm. long, 1.6–2.3 mm. wide, strongly but unequally incurved, the left one further than the right; *keel* 4.2–5.6 mm. long, the claws 1.9–2.5 mm., the nearly half-circular blades 2.7–3.5 mm. long, 1.6–2.2 mm. wide, abruptly incurved through ± 130° to the bluntly deltoid apex; *anthers* 0.35–0.5 mm. long; *pod* pendulous, stipitate, the stipe 1.5–2.5 mm. long, the body linear-oblong or -oblanceolate in outline, straight or very slightly in- or decurved, 1.5–3 cm. long, (2.5) 3–4 mm. in diameter, tapering at base into the stipe, cuneate at apex, triquetrously compressed, bluntly carinate ventrally by the suture, the lateral angles rounded, the lateral faces low-convex, the dorsal face openly sulcate, the thin, green, glabrous valves becoming papery, subdiaphanous, stramineous, lustrous, finely cross-reticulate, inflexed as a complete septum 1.4–1.9 mm. wide; *dehiscence* apical and also from the base upward through the ventral suture; *ovules* 12–16; *seeds* dark purplish- or chestnut-brown, sometimes purple-dotted, nearly smooth or irregularly pitted, somewhat lustrous, 2–2.9 mm. long.—Collections: 18 (v); representative: *Metcalfe 428* (ND, NY, NMC); *Eggleston 17,028, 17,105* (NY); *Barneby 12,901* (CAS, GH, NY, RSA, US), *12,931, 12,945* (CAS, RSA).

Meadows and open pine woods, sometimes along or near streams, in either dry or temporarily moist soils, on basaltic and sometimes granitic bedrock, 6500–8800 feet, rather common locally on and about the Continental Divide in west-central New Mexico, particularly in the Mogollon, San Francisco, Datil, Zuñi, and San Mateo Mountains, extending west to the headwaters of the Little Colorado in the White Mountains, Apache County, Arizona.—Map No. 9.—July to September.

ASTRAGALUS EGGLESTONII (Rydb.) Kearn. & Peeb. in Jour. Wash. Acad. Sci. 29: 484. 1939, based on *Tium Egglestonii* (Willard Webster Eggleston, 1863–1935, student of American hawthorns, etc.) Rydb. in N. Amer. Fl. 24: 396. 1929.—"Type collected in Datil Forest, Socorro County, New Mexico, September 7, 1920, *Eggleston 17216* . . ."—Holotypus, with additional data: "Hillside north of Morley shearing sheds, Datil, 2270 m.," NY!; isotypi, CAS, NY, US!

The Eggleston milk-vetch was collected in Socorro County, New Mexico, at least as early as 1897, by C. L. Herrick; this and subsequent gatherings by Prof. Wooton were misidentified as *A. Rusbyi,* a related species narrowly endemic to central Arizona which differs, inter alia, in its longer stipitate, strigulose pod. Within its area of dispersal in the mountains forming the watershed between the Rio Grande and the Gila and Little Colorado Rivers, *A. Egglestonii* is the only astragalus flowering in late summer with erect stems and very small, loosely racemose, nodding flowers, succeeded by linear-oblong, shortly stipitate, trigonous fruits. The petals are commonly whitish with no hint of pigmentation, though they vary in very dry places to a pale greenish-yellow.

A remarkable plant, provisionally referred to *A. Egglestonii* although differing in several important particulars, has been collected in yellow pine forest, at 6200 feet elevation along Turkey Creek, 6 miles west of Point of Pines and about 70 miles east of San Carlos in northeast Graham County, Arizona (*V. Bohrer 430,* ARIZ, CAS). It differs from the Eggleston milk-vetch in its diffuse, flexuous stems, white-strigulose calyx, leaflets only 13–17 in number, and remotely few- (10–13) flowered racemes. The petals were apparently pinkish when fresh, the dry banner being purple-striate. The pod is like that of *A. Egglestonii,* with stipe 1.5 mm. long and body 2.1 cm. long, 3.5 mm. in diameter, subtrigonous, grooved dorsally and 16-ovulate; but the valves are strigulose. More material is required to establish the status of this form, the aberrant characters of which have been omitted for the present from the specific description.

32. Astragalus micranthus

Caulescent perennial, variable in stature, with a taproot and superficial or very shallowly buried root-crown, thinly strigulose with appressed or narrowly incurved-ascending hairs up to 0.2–0.6 mm. long, the young herbage sometimes cinereous, the mature leaves green or greenish, the leaflets glabrous or nearly so above; *stems* diffuse, prostrate, or weakly incurved-ascending distally, (1) 2–5 dm. long, simple or branched toward the base; *stipules* thinly herbaceous becoming papery, 2–7 mm. long, the lowest small, connate-amplexicaul at least in vernation (sometimes ruptured or deciduous in age), the median and upper ones ovate, deltoid, or lanceolate, more or less amplexicaul-decurrent but free; *leaves* subsessile, 2–8 (10.5) cm. long, with (17) 19–27 (31) linear- or lance-oblong, subacute, truncate-emarginate, or (especially in some lower leaves) ovate and retuse, or (in shaded places) all oblong-elliptic and -obovate, flat or loosely folded leaflets 2–17 (20) mm. long, usually diminishing upward along the rachis; *peduncles* arising from 2–8 of the median and upper axils, erect, or divaricate and incurved, (2) 4–12 (15) cm. long, equaling or often surpassing the leaf; *racemes* densely many (± 30–60, sometimes up to 85)-flowered, narrowly oblong and (1) 1.5–6 (8) cm. long at anthesis, somewhat elongating and (1) 3–9 (16) cm. long in fruit, the flowers and pods retrorsely imbricated or sometimes a few proximal ones more distant; *bracts* membranous or thinly herbaceous, lance-acuminate or elliptic, (1.5) 2–3.5 (4.5) mm. long, reflexed in fruit; *pedicels* at anthesis 0.3–0.8 mm. long, in fruit recurved, somewhat thickened, 0.6–1.5 mm. long, persistent; *bracteoles* 0; *calyx* 2.5–5.6 mm. long, strigulose or villosulous with largely fuscous or black hairs, the strongly oblique disc (0.3) 0.4–0.6 mm. deep, the campanulate tube strongly oblique or a little gibbous dorsally at base, 1.5–3.2 mm. long, 1.3–2.8 mm. in diameter, the subulate, triangular-subulate, rarely shortly deltoid-triangular teeth 0.6–2.6 mm. long; *petals* purple-tinged, sometimes appearing ochroleucous in dried specimens; *banner* abruptly recurved through 70–95° or more, obovate-flabellate or spatulate, 4.5–7 mm. long, 3–6 mm. wide, shallowly notched; *wings* 0.3 mm. shorter to 1.4 mm. longer than the banner, 4.4–7.9 mm. long, the claws 1.8–3.5 mm., the narrowly lanceolate or lunately oblong, obtuse or obscurely emarginate, slightly or (distally) quite strongly and equally incurved blades 2.7–5.1 mm. long, 1.2–2 mm. wide; *keel* nearly as long or a trifle longer than the banner, 3.9–7 mm. long, the claws 1.8–3.6 mm., the half-obovate or -elliptic blades 2.4–4.2 mm. long, (1.6) 1.8–2.4 mm. wide, incurved through 70–90° to the blunt, deltoid apex; *anthers* 0.35–0.45 mm. long; *pod* reflexed, sessile or nearly so, the stipe not over 0.5 mm. long, usually obsolete, persistent on the receptacle, oblong-elliptic to lanceolate in profile, straight or gently incurved, 5.5–13 mm. long, 2.2–3.5 mm. in diameter, obtuse at base, apiculate at apex, obtusely triquetrous, keeled ventrally by the straight or gently concave suture, openly sulcate dorsally, the thin, greenish-stramineous, black- or more rarely white-strigulose or minutely incurved-villosulous valves turning brown or blackish, thinly papery, faintly reticulate, inflexed as an incomplete septum 0.4–1.5 mm. wide; *dehiscence* apical and downward through the ventral suture; *ovules* 6–16; *seeds* brown, sometimes minutely purple-dotted, nearly smooth, 1.5–1.6 mm. long.

The Mexican milk-vetch, *A. micranthus,* one of the commonest astragali native to the mountain ranges enclosing the Valley of Mexico, is easily recognized once its essential features are familiar, even though it is variable and in some aspects easily mistaken for some other small-flowered species. Care must be taken to distinguish its most frequent form, var. *micranthus,* from *A. Hartwegii,* often like it in the long, dense racemes of tiny, deflexed, and retrorsely imbricated flowers, but differing in the free lower stipules and ultimately disjointing fruit; and

from *A. hypoleucus,* which may have a similar inflorescence, but foliage cinereous with dolabriform (not basifixed) hairs. The numerous flowers usually suffice to distinguish *A. micranthus* from other *Strigulosi* with small, sessile or subsessile fruits.

Herbarium labels report *A. micranthus,* sens. lat., as occurring in a variety of habitats: openings in dry pine forest, meadows in the mountains which may be either dry or temporarily moist, and barrancas in mesophytic oak woods. The plants seem to vary accordingly from low and very slender to coarse and tall, the stems fluctuating from about 1 to 4 mm. in diameter. The more robust individuals tend to have more numerous and broader leaflets, longer racemes of more numerous and slightly larger flowers, longer pods, and more numerous ovules. The plentiful material presents a picture of gradual transition from the slender extreme described as *A. Seatoni* into robust phases providing the typi of *A. Rosei, A. saltonis, A. Seatoni* var. *crucis,* and the original *A. micranthus.* An attempt to divide the species into varieties corresponding with the already named segregates would be purely artificial; however for geographic reasons, it is reasonable to set apart the very delicate extreme from the Orizaba massif, our var. *Seatoni,* from the widespread and variable var. *micranthus.*

Key to the Varieties of A. micranthus

1. Plants variable in stature but often quite coarse, the stems (1.5) 2–5 dm. long; *racemes* 30–60-flowered, the axis 3–10 (16) cm. long in fruit; *calyx* (3.8) 4–5.6 mm. long, the teeth 1.1–2.2 (2.6) mm. long; *banner* (4.9) 5.1–7 mm. long; *pod* 8.5–13 mm. long; *ovules* 8–14 (16); relatively widespread, but unknown from the Orizaba massif ..... 32a. var. *micranthus*

1. Plants very slender, the stems 1–2.5 dm. long; *racemes* 15–30-flowered, (1) 1.5–3.5 cm. long in fruit; *calyx* 2.5–3.1 mm. long, the teeth 0.6–1.1 mm. long; *banner* 4.5–5.2 mm. long; *pod* 5.5–8 mm. long; *ovules* 6–7; Mt. Orizaba and vicinity ..... 32b. var. *Seatoni*

32a. Astragalus micranthus var. micranthus

Characters as given in the key; *leaflets* relatively numerous, mostly 21–31, varying from linear-oblanceolate to much broader; *calyx-tube* 2.1–3.2 mm. long, 2.1–2.8 mm. in diameter; *banner* (3.5) 4–6 mm. wide; *wings* (0.3 mm. shorter to 1.4 mm. longer) 6.1–7.9 mm. long, the claws (2.1) 2.3–3.5 mm., the blades 4–5.1 mm. long, 1.4–2 mm. wide; *keel* (4.8) 5–7 mm. long, the claws (2) 2.4–3.6 mm., the blades (2.7) 3.1–4.2 mm. long, (1.6) 1.9–2.4 mm. wide; *pod* 2.6–3.5 mm. in diameter, straight, slightly decurved, or gently incurved, the septum 0.7–1.5 mm. wide, sometimes nearly complete.—Collections: 32 (o); representative: *Bourgeau 337* (G, GH, K, P); *Rose, Painter & Rose 8811* (NY, US); *Lyonnet 701* (NY, US); *Rose & Painter 7166* (GH, NY, US); *Arsène 10,990* (CAS, NY, US); *Pringle 13,780* (US); *Rose & Hough 4718* (US); *Hitchcock & Stanford 7031* (US, WS).

Sunny slopes and openings in pine forest, moist or dry mountain meadows, sometimes on damp hillsides among oaks, ± 8300–10,300 feet, common and locally plentiful in the mountains encircling the Valley of Mexico, from southern Hidalgo to northern Morelos and eastcentral Puebla.—Map No. 7.—June to December.

Astragalus micranthus (small-flowered) Desv., Jour. Bot. 3: 78. 1814.—"In hortis colitur." (no origin given).—Holotypus, "ex Hort. Paris., 1809; habitat in Mexico," P (herb. Desv.)! isotypus, P (herb. Poir.)!

Astragalus Hartwegii fma. *Pringlei* (Cyrus Guernsey Pringle, 1838–1911) Gand. in Bull. Soc. Bot. Fr. 48: xv. 1901.—"... Pringle (*Pl. Mexicanae,* no. 7595) ... Hab. Mexico, Hidalgo in valle Tula, alt. 6800 ped."—Holotypus, collected July 13, 1898, LY!—No duplicates of this collection found in U. S. herbaria.

Astragalus Seatoni var. *crucis* (of Sierra de Las Cruces) Jones, Rev. Astrag. 281. 1923 (*"Crucis"*).—"Pringle's No. 6445, Sierra de las Cruces at 10,000 ft. alt., state of Mexico, August 13, 1896." Holotypus, US! isotypi, CAS, G, ND, NY, P!

Astragalus Rosei (Joseph Nelson Rose, 1862–1928, especially known for work on *Umbelliferae* and *Cactaceae*) Jones, Rev. Astrag. 190, Pl. 43. 1923.—"Above Dos Rios in the state of Mexico, Sept. 4, 1904 by Rose and Painter, Nat. Herb. No. 450372."—Holotypus *(Rose &*

Painter 6815), US! isotypus, labeled "Guadelupe, Valley of Mexico," NY!—*Atelophragma Rosei* (Jones) Rydb. in Bull. Torr. Club 55: 163. 1928.

Astragalus saltonis (of Salto de Agua) Jones, Rev. Astrag. 279, Pl. 70. 1923 *("Saltonis").* —"'Salto de Aqua [sic], Mexico, state of Mexico, No. 1751 Purpus.'"—Holotypus, collected in November, 1905, POM! isotypus, UC!—*Hamosa saltonis* (Jones) Rydb. in Bull. Torr. Club 54: 332. 1927.

The pod of var. *micranthus,* as defined in these pages, is variable in length and correspondingly in ovule-number; and more strikingly so in curvature. Most commonly the pod is straight, more rarely it is a little arched downward, but especially when relatively long it may become gently incurved. An incurved pod is the one diagnostic feature of *A. saltonis* that was accordingly referred by Jones to his sect. *Micranthi* (a section based on *A. micranthus* Nutt., non Desv.) and by Rydberg to the genus *Hamosa.* Examining Jones's key to the *Micranthi* (1923, p. 273), I find that his *A. Seatoni* was separated from *A. saltonis* by its shorter fruit (not over 7 mm. as opposed to 10 mm. or more long); but in the text (p. 281) the pod of *A. Seatoni* var. *crucis* was described as 8–12 mm. long, clearly falling into the range of *A. saltonis.* Rydberg evaded the responsibility of contrasting *A. (Hamosa) saltonis* with *A. (Atelophragma) Rosei* by placing them in separate genera; and by assigning *Atelophragma Rosei* and *A. Seatoni* to different sections defined in terms of flower-size (often incorrectly observed or reported), he avoided the problem posed by specimens with flowers falling between the critical upper limit of 5 mm. and lower one of 6 mm. in length. The combination *A. Seatoni* var. *crucis* was overlooked in *North American Flora,* but the isotypus at NY is annotated as *A. Seatoni* in Rydberg's hand despite its flower-length in excess of 7 mm. The confusion in Rydberg's mind as to the boundaries of these supposed species is especially evident in the light of annotations at US and NY. Thus he referred *Nicolas & Arsène 105,* with pod only 6 mm. long but relatively large flowers, to *A. Rosei*; and it would be possible to quote many equally contradictory examples.

The history of *A. micranthus* goes back to the earliest days of botanical exploration in Mexico. It was first collected by Sessé or Mociño (*Herb. Sessé & Mociño Nos. 3637, 3746,* MA; OXF) late in the XVIII century. It was under cultivation in Paris by 1809; unfortunately nothing was recorded as to the source of the seeds. It is possible, but by no means certain, that *Phaca triangularis* Zea ex Hornem., Hort. Hafn., Suppl. 83. 1819.—"Hab.——... intr. 1817 ex horto *Gorinkiano* sub hoc nomine."—(*Astragalus triangularis* (Zea ex Hornm.) DC., Prod. 2: 291. 1825) is an early synonym; a validating specimen is to be sought at Copenhagen.

32b. Astragalus micranthus var. Seatoni

Characters as given in the key; *leaflets* mostly 17–23, linear or linear-oblanceolate; *calyx-tube* 1.5–2 mm. long, 1.9–2 mm. in diameter; *banner* 3–3.5 mm. wide; *wings* (0.1–0.5 mm. shorter) 4.4–4.8 mm. long, the claws 1.8–2.3 mm., the blades 2.7–3.3 mm. long, 1.2–1.5 mm. wide; *keel* 3.9–4.6 mm. long, the claws 1.6–2.1 mm., the blades 2.4–2.8 mm. long, ± 1.8 mm. wide; *pod* 2.2–3 mm. in diameter.—Collections: 4 (o); representative: *Pringle 8562* (NY, P, US); *Rose & Hay 5660* (GH, US).

Open hillsides, 900–10,000 feet, known only from the Orizaba massif in Puebla and adjoining Vera Cruz.—Map No. 7.—July to September.

Astragalus micranthus var. Seatoni (Jones), stat. nov., based on *A. Seatoni* (Henry Eliason Seaton, 1869–1893) Jones in Proc. Calif. Acad. Sci. II, 5: 676. 1895.—"Collected by H. E. Seaton, on Mt. Orizaba, Mexico, 10,000° alt., August 6, 1891."—Holotypus, US! isotypi, GH, K, NY!—*Atelophragma Seatoni* (Jones) Rydb. in Bull. Torr. Club 55: 164. 1928.

The var. *Seatoni* is known by precise locality-data only from the slopes of Orizaba above Chalchicomula and from near Perote. Comparison of the descriptions and characters given in the varietal key shows that in each measured organ var. *Seatoni* stands at or barely below the low extreme recorded for var. *micranthus*; but as the reductions in size occur simultaneously, the result is more impressive than might be expected. The Seaton milk-vetch is an extremely delicate little plant, remarkable for its tiny, crowded flowers and very small, thin-walled pod. In southern Mexico it might possibly be confused with *A. pueblae,* but this differs amply in its longer stems, few leaflets, subumbellate racemes of only a dozen flowers or less, and in its similarly fashioned but unilocular pod.

The Seaton milk-vetch was collected first, in relatively robust form, by Sessé & Mociño (MA) about 1800, but no locality was recorded. It was then encountered at Perote by Schiede

& Deppe, about 1828. Schiede's specimens (as represented at P), which had been identified by Schlechtendal (in Linnaea 5: 582. 1832) as *A. canadensis,* were recognized by Bunge as representing a species undescribed at the time (ca. 1860). Bunge's manuscript name, honoring Schlechtendal, was never published. During the preliminary studies, before I had seen authentic *A. micranthus,* I annotated many sheets of var. *Seatoni* as *A. Seatoni,* and many of var. *micranthus* as *A. Seatoni* var. *crucis.*

33. Astragalus esperanzae

Low, rather slender, caulescent perennial, with a taproot and shortly forking, superficial or partly buried caudex (the branches sometimes elongating as though rhizomatous), strigulose nearly throughout with fine appressed or some narrowly ascending, straight hairs up to 0.25–0.5 mm. long, the herbage cinereous, the leaflets glabrous above; *stems* few or several, diffuse, (0.5) 1–2.5 (3) dm. long, simple or few-branched toward the base, floriferous at (1) 2–6 nodes upward from near or below the middle; *stipules* 2–6 mm. long, all connate-amplexicaul, the small lowest ones forming a papery-membranous sheath, the upper united at base only or through half their length, with lanceolate, thinly herbaceous, mostly erect blades; *leaves* subsessile, (2) 3–8 (12) cm. long, with (11) 15–23 (25) linear-oblong, -oblanceolate, or rarely oblong-obovate, obtuse or commonly retuse, flat or folded leaflets 3–13 (18) mm. long; *peduncles* incurved-ascending, (1.5) 3–11 (14) cm. long, often a little longer than the leaf; *racemes* densely 10–25-flowered, the flowers at first ascending, early spreading and ultimately declined, the axis little elongating, 1–3 cm. long in fruit; *bracts* membranous, ovate or lanceolate, 1.5–3 mm. long; *pedicels* at anthesis 0.6–1.2 mm. long, in fruit arched outward or recurved, thickened, 1–1.7 mm. long, persistent or very tardily disjointing with the pod; *bracteoles* 0–2; *calyx* 4.5–6.2 mm. long, strigulose with black and sometimes a few white hairs, the somewhat oblique disc 0.5–0.7 mm. deep, the campanulate tube 2.5–3.5 mm. long, 2.2–3.3 mm. in diameter, the subulate teeth (1.5) 1.8–3 mm. long, the whole becoming papery-membranous, ruptured and ultimately irregularly circumscissile; *petals* purplish, or at least the banner purple-tinged; *banner* gently recurved through ±45°, ovate- or obovate-cuneate, shallowly and openly notched, (7.4) 7.8–9.4 mm. long, 5–5.8 mm. wide; *wings* (0.3 mm. shorter to 0.9 mm. longer) 7.6–9.6 mm. long, the claws 2.5–3.5 mm., the narrowly oblong or oblong-oblanceolate, obliquely truncate-emarginate, slightly and equally incurved blades 5.7–7.2 mm. long, 2–2.4 mm. wide; *keel* (5.8) 6–7.7 mm. long, the claws 2.6–3.5 mm., the half-obovate blades (3.3) 3.5–4.8 mm. long, 2.2–2.7 mm. wide, abruptly incurved through 90–95° to the broadly rounded apex; *anthers* 0.4–0.55 mm. long; *pod* declined or deflexed, sessile on and firmly attached to the receptacle, lanceolate, linear-lanceolate, or slenderly ovate-acuminate in profile, very slightly to crescentically incurved, (1.1) 1.2–1.8 cm. long, (2.5) 3–4 mm. in diameter, rounded at base, contracted distally into a short, subulate beak, triquetrously compressed, carinate ventrally by the 3-costate or narrowly winged suture, the lateral angles rounded, the dorsal face deeply and narrowly grooved, the pale green, glabrous or very thinly black- or white-strigulose valves becoming rather stiffly papery, stramineous, or ultimately blackish-brown, inflexed as a complete septum 1.2–1.6 mm. wide; *dehiscence* apparently apical, not well observed; *ovules* 14–18; *seeds* brown, smooth, sometimes purple-speckled, (1.7) 1.9–2.1 mm. long.—Collections: 12 (o); representative: *Pringle 6955, 7644* (CAS, MICH, NY); *J. N. Rose 2757* (GH, NY, US); *Rose, Painter & Rose 8409, 8828* (US); *Pennell 17,764* (NY).

Dry hillsides, ± 6000–8000 feet, southern Zacatecas and San Luis Potosí, south to Lake Chapala, Jalisco, and Morelos, Hidalgo, and Puebla.—Map No. 10.—May to October.

ASTRAGALUS ESPERANZAE (of Esperanza, Puebla) Jones, Rev. Astrag. 277, Pl. 70. 1923 (*"Esperanzae"*).—"Esperanza, Puebla Mexico, No. 3207 Purpus . . . "—Holotypus, collected in August, 1908, POM! isotypus, UC!—*Hamosa esperanzae* (Jones) Rydb. in Bull. Torr. Club 54: 335. 1927.

Astragalus chapalanus (of Chapala, Jalisco) Jones, Rev. Astrag. 277, Pl. 70. 1923 (*"Chapalanus"*).—"Near Chapala, Jalisco Mex., Oct. 5, 1903, J. N. Rose . . . "—Holotypus, *Rose & Painter 7627*, US! isotypus, NY!—*A. chapalensis* Jones ex Rydb. in Bull. Torr. Club 54: 335, in syn. 1927.

Hamosa asperula (roughish, of the strigulose pod) Rydb. in Bull. Torr. Club 54: 335. 1927.—" . . . collected between Pachuca and Real del Monte, Hidalgo, Aug. 31, 1903, *Rose & Painter 6679* . . . "—Holotypus, US!

The affinities of *A. esperanzae* are not readily apparent, and the species seems somewhat isolated taxonomically. On account of the sessile, lunately incurved, fully bilocular pod it was referred by Jones to his sect. *Micranthi*, and by Rydberg to the nearly equivalent genus *Hamosa*; but a pod persistent on the receptacle combined with connate stipules has no counterpart in either group. On the other hand *A. esperanzae* agrees in technical features of flower and stipule with *A. micranthus*, and its fruit is quite like that of some forms of the relatively robust var. *micranthus*, even though longer and of thicker texture. The species is distinguished further from *A. micranthus* as a whole by its substantially larger and fewer, shortly racemose flowers. Unlike the commonly montane *A. micranthus*, the Esperanza milk-vetch is a plant of hot and dry habitats in the foothills.

The pod of *A. esperanzae* varies from glabrous to thinly strigulose. The first known collection (*Sessé & Mociño Herb. Nos. 1904, 3644*, MA), which antedates the typus by well over a century, is of the puberulent sort. Since, however, both states have been found growing close together in the Sierra de Pachuca, and the plants do not differ otherwise, it is unquestionably correct to treat the pubescent *H. asperula* as a minor variant. Rydberg must have overlooked the fact that the typus of *A. chapalanus*, which he reduced to *A. esperanzae*, also has a puberulent pod.

The reduction of *A. chapalanus*, in which I am content to follow Rydberg for the present, may require revision in the future. The species was described by Jones from incomplete specimens collected in October when all the flowers were past, and the material is really inadequate for analysis. The pod is essentially identical with that of *A. esperanzae*, but the stipules, as Jones (1923, p. 273) particularly emphasized in his key to sect. *Micranthi*, seem to be all free, although the sheath may perhaps have been ruptured artificially and from some specimens the whole stipule has been rubbed off in the press. One fragmentary calyx about 3 mm. long suggests that the flower of *A. chapalanus* was appreciably smaller than that of *A. esperanzae*. No attempt has been made to incorporate the aberrant characters of *A. chapalanus* into the specific description, but they may be noted as follows:

Hairs up to 0.2 mm. long; *stipules* 1.5–2.5 mm. long, apparently only semiamplexicaul, free; *leaves* 2.5–4 cm. long, with 17–21 narrowly oblong-oblanceolate leaflets 4–10 mm. long; *peduncles* 2.5–3.5 cm. long; *racemes* shortly and rather densely 7–12-flowered, the axis 1–2 cm. long in fruit; *calyx* (?) 3 mm., the teeth about 1.2 mm. long.

34. ASTRAGALUS COBRENSIS

Low, slender perennial, with a woody taproot and loosely forking, subterranean caudex, thinly strigulose to densely hirsutulous, the herbage green or cinereous, the leaflets ± bicolored, pallid beneath, yellowish-green and either glabrous or thinly pubescent above; *stems* few or several, decumbent and weakly ascending, (4) 6–20 (25) cm. long, subterranean for a space of 1.5–10 (15) cm., simple or bearing 1 (2) branches just above soil-level, flexuous or zigzag distally; *stipules* 1.5–5 mm. long, those at the lowest, leafless nodes papery or early becoming so, connate into a low, loosely amplexicaul collar or shortly campanulate, bidentate sheath, the median and upper ones united through half their length or only at base, with triangular-lanceolate, thinly herbaceous, mostly erect blades; leaves 1.5–8 (11) cm. long, shortly petioled or the uppermost subsessile, with (7) 11–19 (23) broadly obovate, obovate-cuneate, broadly oblong-elliptic, or suborbicular, retuse, flat leaflets (1.5) 3–12 (17) mm. long; *peduncles* slender, incurved-ascending, (1) 1.5–8.5 cm. long, equaling or a little shorter than the leaf; *racemes* loosely (4) 8–22 (33)-flowered, the flowers spreading and ultimately declined,

the axis elongating, (1) 2–6 (7.5) cm. long in fruit; *bracts* membranous, purplish, ovate or ovate-acuminate, 1–2.2 mm. long; *pedicels* slender, at anthesis ascending or arched outward, 1–2 mm. long, in fruit more strongly arched or deflexed, 1.3–2.5 (3) mm. long, persistent; *bracteoles* 0; *calyx* 3.2–4.5 mm. long, loosely strigulose with black or fuscous, and often a few intermingled white hairs, the slightly oblique saucer- or top-shaped disc 0.4–0.8 mm. deep, the campanulate or turbinate-campanulate tube 2.2–2.7 mm. long, 1.6–2.2 mm. in diameter, the subulate teeth 1–1.8 mm. long, the whole becoming papery, a little distended but unruptured; *petals* whitish tinged with dull lilac; *banner* at full anthesis recurved through ± 85°, broadly obovate-cuneate, -flabellate, or rhombic-ovate, deeply and widely notched, 6.5–7.8 mm. long, 4.2–5.8 mm. wide; *wings* a trifle longer or shorter than the banner, 6.2–7.7 mm. long, the claws 1.9–2.6 mm., the triangular-obovate, or broadly and obliquely elliptic, obtuse but erose or minutely undulate blades 4.2–5.9 mm. long, 1.7–3 mm. wide, the left one slightly incurved, the right abruptly bent inward at a right angle with the claw and its inner margin infolded; *keel* 4.4–6 mm. long, the claws 1.9–2.7 mm., the half-obovate or -circular blades 2.5–3.8 mm. long, 1.7–2.3 mm. wide, abruptly incurved through 95–100° to the blunt, or sharply deltoid and obscurely porrect apex; *anthers* 0.3–0.55 mm. long; *pod* pendulous, subsessile, the obscure stipe no longer than the calycine disc and often subobsolete, the body oblong- or somewhat clavate-ellipsoid, (7) 9–15 mm. long, 3.5–6 (reportedly "7") mm. in diameter, straight or a trifle arched downward, cuneate at base, abruptly contracted at apex into a very short, triangular, cuspidate beak, obcompressed, with low-convex ventral face obtusely carinate by the thick suture, flattened or widely and openly sulcate dorsally, the greenish, strigulose or villosulous valves becoming papery, stramineous, delicately cross-reticulate, inflexed as a partial or nearly complete septum 0.8–1.3 mm. wide; *dehiscence* apical and downward through the length of the ventral suture, the valves tending to twist outward in age; *ovules* 10–13; *seeds* brown, pitted and rugulose but somewhat lustrous, 2.4–3 mm. long.

The Copper Mine milk-vetch, *A. cobrensis,* is a lowly, inconspicuous but nonetheless quietly elegant astragalus, often remarkable for the length of the buried caudex-branches which may be as long or longer than the aerial stems and are beset with prominent scaley stipule-sheaths. The habit of growth recalls the dwarfer, small-flowered *Scytocarpi,* although the strongly obcompressed and partly bilocular pod is characteristic of sect. *Strigulosi.* Like the related *A. recurvus,* with which it is marginally sympatric in central Arizona, *A. cobrensis* flowers in spring, and both species fluctuate in numbers and in vigor from year to year in response to depth of winter rainfall. Most other *Strigulosi,* whether native to the United States or Mexico, await the summer rains before starting into active growth, and the adaptation to vernal flowering may well be, with these two species, a reversion to the condition primitive in the genus.

The species, uniform over the great part of its range, has given rise to one striking variant in the Chiricahua Mountains, acceptable as a variety.

Key to the Varieties of A. cobrensis

1. Herbage thinly strigulose with fine, appressed (rarely a few longer and looser) hairs up to 0.25–0.45 (0.6) mm. long, the leaflets glabrous or nearly so above; *pod* strigulose; range of the species except the Chiricahua Mountains ..... 34a. var. *cobrensis*
1. Herbage and stems pilosulous with rather stiff, spreading and incurved-ascending hairs up to 0.6–0.8 mm. long; *pod* white-villosulous; Chiricahua Mountains, Arizona ..... 34b. var. *Maguirei*

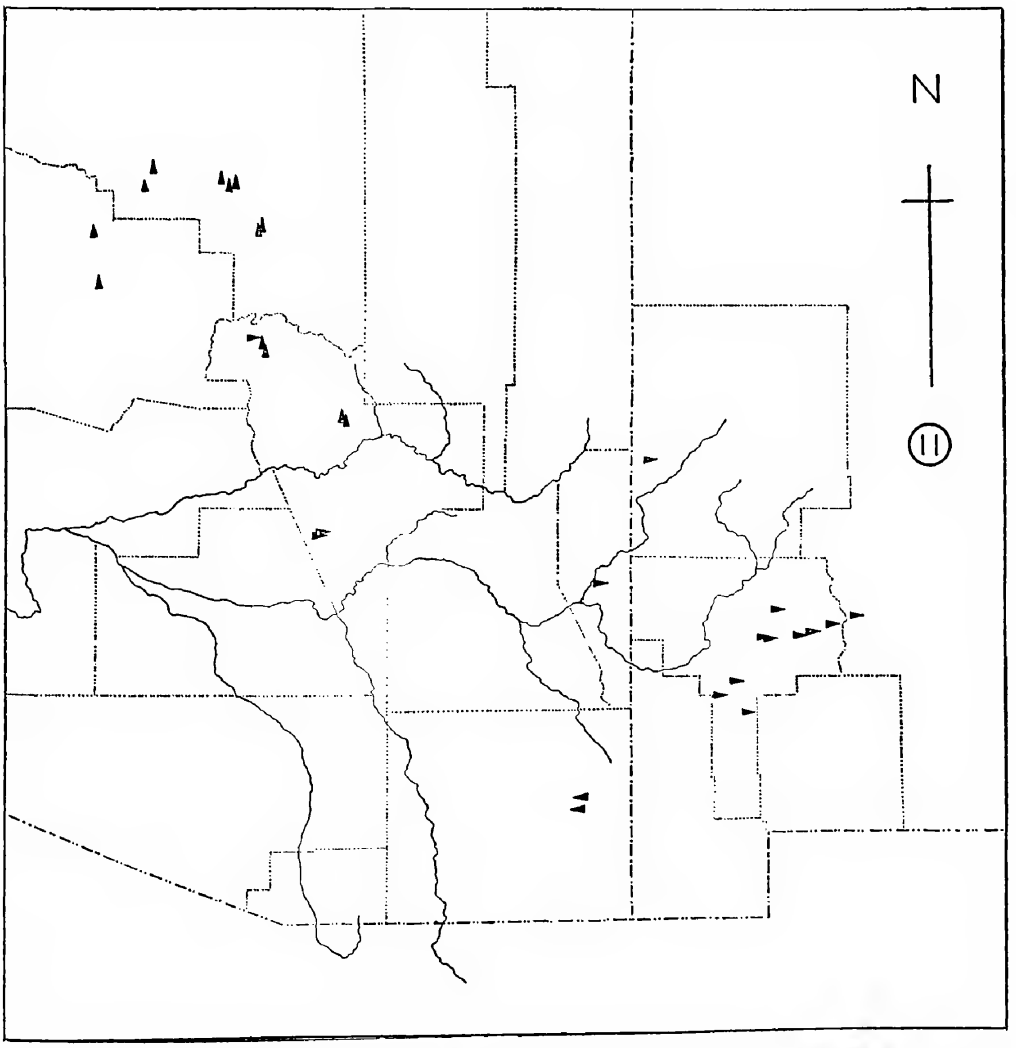
34a. Astragalus cobrensis var. cobrensis

Pubescence of the whole plant appressed or subappressed.—Collections: 17 (iv); representative: *Jones 26,186* (CAS, POM); *Eastwood 8222, 8318* (CAS); *Rusby 91* (NY, WS); *Ripley & Barneby 11,171* (CAS, RSA); *Barneby 12,641* (CAS, NY, RSA).

Dry sandy or gravelly hillsides, in walnut groves, about oak thickets, and in yellow pine forest, 5500–7800 feet, local and usually in small scattered colonies, foothills and lower slopes of the Black Range and of the Pinos Altos, Burro, and San Francisco Mountains in western Sierra, Grant and western Catron Counties, New Mexico, west to the Pinal Mountains in Gila County, Arizona.—Map No. 11.—Mid-March to May, sometimes sporadically in fall.

ASTRAGALUS COBRENSIS (of Santa Rita del Cobre) Gray, Pl. Wright. 2: 43. 1853.—"... found ... by Dr. Bigelow ... near the *Cobre* or copper mines (Santa Rita del Cobre), New Mexico; April or May."—Holotypus, collected by Bigelow in 1851, GH! isotypus, NY!—*Tragacantha cobrensis* (Gray) O. Kze., Rev. Gen. 944. 1891. *Atelophragma cobrense* (Gray) Rydb. in Bull. Torr. Club 55: 162. 1928.

The Copper Mine milk-vetch is apparently confined within the watershed of the Gila River except that it extends to the east slope of the Black Range which drains to the Rio Grande. Jones (1923, p. 188) and Hemsley (1880, p. 263) have reported the species from Coahuila, but both records were probably copied from that of Torrey in *Botany of the Mexican Boundary Survey* (1859, p. 55) in which the range is given as "Copper Mines, New Mexico, April and Ben Moore, Coahuila, June (fruit); Bigelow." There was a mountain named



Map No. 11. Southeastern Arizona and southwestern New Mexico. Range of ▲ *A. recurvus*; and of *A. cobrensis*: ◗ var. *cobrensis*; and◖ var. *Maguirei*.

Ben More or Ben Moore near Santa Rita del Cobre which was visited by Emory and by Charles Wright (cf. Standl. in Contrib. U. S. Nat. Herb. 13: 152. 1910), and this is the source of Torrey's plant. We can, however, reasonably expect *A. cobrensis* to be traced into the mountains of northwestern Chihuahua or adjoining Sonora, a region floristically related to mountainous southwestern New Mexico.

34b. Astragalus cobrensis var. Maguirei

Pubescence of the whole plant, but particularly of the stems, stiff and spreading.—Collections: 2 (o); representative: *Foster & Arnold 204* (ARIZ).

Habitats of var. *cobrensis,* but known only from the Chiricahua Mountains (Pinery and White Tail Canyons), Cochise County, Arizona.—Map No. 11.—April and May.

Astragalus cobrensis var. Maguirei (Bassett Maguire, 1904–) Kearney in Jour. Wash. Acad. Sci. 30: 218. 1940.—"Type from White Tail Canyon, Chiricahua Mountains, Cochise County, Ariz., . . . *Bassett Maguire et al.* 11079, May 2, 1935."—Holotypus, collected by Maguire, Richards & Moeller, US! isotypi, ARIZ, UTC!

35. Astragalus microcymbus

Slender, diffuse perennial, with a taproot and shallowly buried root-crown, loosely strigulose or subvillosulous with fine, ascending or incumbent hairs up to 0.4–0.5 mm. long, the stems purplish, the herbage pallid green and cinereous, the leaflets somewhat bicolored, brighter green and more thinly pubescent above than beneath; *stems* several, prostrate and weakly ascending, 2.5–6 dm. long, subterranean for a space of 2–3 cm., forking below the middle into one or more principal branches and these again branched, the secondary divisions short and slender, often paired with an axillary peduncle which together pass upward into unequal pairs of peduncles, the whole forming somewhat intricate and floriferous sprays; *stipules* 1.5–3 mm. long, the lowest amplexicaul and connate into a fragile, papery-scarious, subtruncate, collar-like sheath, the median and upper ones membranous, deltoid or triangular-acuminate, semiamplexicaul and free, or some of them united by a stipular line, the blades deflexed; *leaves* divaricate or deflexed, (1.5) 2–4 cm. long, shortly petioled or the upper ones subsessile, with 9–15 rather crowded, oblong-obovate or obovate-cuneate, emarginate, folded leaflets 3–9 mm. long; *peduncles* divaricate and ascending, slender or filiform, (0.8) 1.5–3.5 cm. long, shorter than the leaf; *racemes* loosely (3) 7–14-flowered, the flowers early spreading and at length declined, the axis (1) 2–6.5 cm. long in fruit; *bracts* membranous, ovate, 0.8–1.4 mm. long; *pedicels* at anthesis 0.5 mm. long, becoming arched outward and downward, 1–1.4 mm. long in fruit, not or very tardily disjointing; *bracteoles* 0; *calyx* 2.2–2.6 mm. long, loosely strigulose with white and some fuscous hairs, the subsymmetric disc 0.4–0.5 mm. deep, the campanulate or obconic-campanulate tube 1.4–1.9 mm. long, 1.4–1.5 mm. in diameter, the subulate teeth 0.5–0.7 mm. long, the whole becoming papery, marcescent either partly ruptured or unruptured; *petals* whitish tinged with lilac, the keel tipped with dull purple; *banner* recurved through ± 45°, broadly elliptic or obovate-cuneate, deeply notched, 5.6–5.8 mm. long, 3–3.3 mm. wide; *wings* 4.8–5.1 mm. long, the claws 1.6–1.7 mm., the obliquely obovate, truncate or emarginate blades 3.5–3.7 mm. long, 1.6–1.8 mm. wide, the left one more strongly incurved and a trifle wider than the right, its inner margin folded over the keel; *keel* 3.5–3.7 mm. long, the claws 1.5–1.6 mm., the broadly triangular blades 2.1–2.3 mm. long, 1.2–1.4 mm. wide, abruptly incurved through 95–100° to the sharply deltoid, sometimes obscurely porrect apex; *anthers* 0.25–0.3 mm. long; *pod* pendulous, obscurely stipi-

tate, the stipe about 0.4 mm. long, concealed by the calyx, the body ellipsoid or lance-ellipsoid, slightly decurved, 6–9 mm. long, (2.5) 3–3.3 mm. in diameter, acute at both ends, obcompressed, the ventral face high-convex and carinate by the prominent suture, the dorsal face openly and deeply sulcate, the thin, green but purple-speckled, white-villosulous valves becoming papery, stramineous, finely cross-reticulate, inflexed, if at all, as a rudimentary hyaline septum not over 0.1 mm. wide; *dehiscence* apical and ultimately through the length of the ventral suture and the stipe; *ovules* 4–6; *seeds* dark chestnut-brown or purplish-black, rugulose but somewhat lustrous, 2.5–2.9 (3.1) mm. long.—Collections: 2 (i); representative: *W. A. Weber 9144* (NY).

Dry, sandy and gravelly roadside, in the sagbrush zone, 7600–7700 feet, known only from the type-locality in Gunnison Valley near Gunnison, Colorado, there very likely adventive and the true home and habitat to be discovered—Not mapped.—July to August.

ASTRAGALUS MICROCYMBUS (little boat, the pod resembling an inverted skiff) Barneby in Amer. Midl. Nat. 41: 499. 1949.—"COLORADO: . . . four miles west of Gunnison, Gunnison Co., . . . 20 July 1945, fl. & fr., *Ripley & Barneby No. 7179.*"—Holotypus, CAS!; isotypi, COLO (fragment), GH, RSA!

The skiff milk-vetch, *A. microcymbus,* is a species of uncommon interest because of its morphology, its relationships, its great rarity (so far as known today), and its enigmatic origin. It was originally compared with *A. cobrensis,* from which it is easily distinguished by its longer, freely branched stems, fewer leaflets, subunilocular pod, and few (4–6) ovules; and I hold to the opinion that its relationships lie in the direction of the small-flowered *Strigulosi* with asymmetric wing-petals. It can, however, scarcely be excluded on technical grounds from Sect. *Scytocarpi,* although the repeated and diffuse branching of the stems, a feature not uncommon among the *Strigulosi,* and very narrow but often demonstrable septum point away from the former section. In practice it could be confused only with *A. gracilis* within the *Scytocarpi;* but this has a pod of fleshy, ultimately leathery texture, transversely rugulose-reticulate and strictly unilocular.

Peduncles borne in unequal pairs in the upper axils or, lower on the stems, paired with an axillary branchlet, are characteristic of *A. microcymbus,* and are known also in *A. Lemmoni,* and in many or most populations of *A. tenellus* and *A. Preussii.* The lesser of a given pair of peduncles evidently represents the rudiment of an otherwise suppressed branchlet, and this unusual mode of branching must have arisen independently in each case, for the species mentioned have little else in common.

The type-locality of *A. microcymbus* is a strip of gravelly roadside a few yards wide and perhaps a hundred paces long, and the species has yet to be traced to a more natural and undisturbed habitat. It was first collected in failing light at the end of a long day in the field, and the unique character of the few specimens obtained was not appreciated until much later. In the decade following its discovery I revisited the locality, as did William A. Weber, but the astragalus eluded our search and seemed temporarily to have disappeared. In 1955 Dr. Weber made a second and this time successful attempt to learn more about *A. microcymbus,* and I cannot do better than quote the letter received from him shortly after (in correspondence, dated July 23, 1955): "I took another look this year for *Astragalus microcymbus* and am happy to say that I was able to find it this time, growing in the exact locality, in good flower and fruit. I went over the area carefully and counted a total of 11 plants . . . Feeling that the plants must have come down the arroyos from above, I spent a whole morning going over the territory above but couldn't find anything. I came away with the conviction that the species is a waif at the locality, and I think it might be wise to restudy the thing with that possibility in mind . . . The plants are evidently maintaining themselves, but the population is extremely small, and likely to be destroyed whenever the highway department decides to fix the road. I imagine that in a dry year the plants must hardly show above ground." Although I have returned repeatedly to study and ponder the relationships of *A. microcymbus,* I cannot refer the material to any species known to me in America, and there seems to be no described Old World or South American group to which it could be assigned. If not native to Gunnison Valley (and I agree with Dr. Weber that it is very likely introduced at the type-station), I should expect its home to lie southward from Colorado, very possibly in Mexico where the *Strigulosi* are most highly developed.

VIII. Sectio SCALARES

Perennial or biennial (perhaps sometimes flowering the first season), with slender, erect, upwardly branching stems from a taproot and superficial root-crown; *vesture* basifixed, scanty; *stipules* small, free; *leaves* imparipinnate, with about 17–31 leaflets; *flowers* loosely or remotely racemose, very small, the moderately recurved banner about 5.5–6.5 mm. long; *pedicels* thickened in fruit, persistent; *calyx-tube* shallowly campanulate; petals pale purple, regularly but only slightly graduated, the keel obtuse; *pod* spreading or declined, very shortly stipitate, often appearing subsessile, the body obliquely obovoid, about 5–8 mm. long, obtusely trigonous, shallowly sulcate dorsally, uni- or subunilocular, the valves papery; *dehiscence* apical and part way down through the ventral suture; ovules 4–7 (9).—Sp. 1, of soils moist in summer, Sierra Madre, Chihuahua.

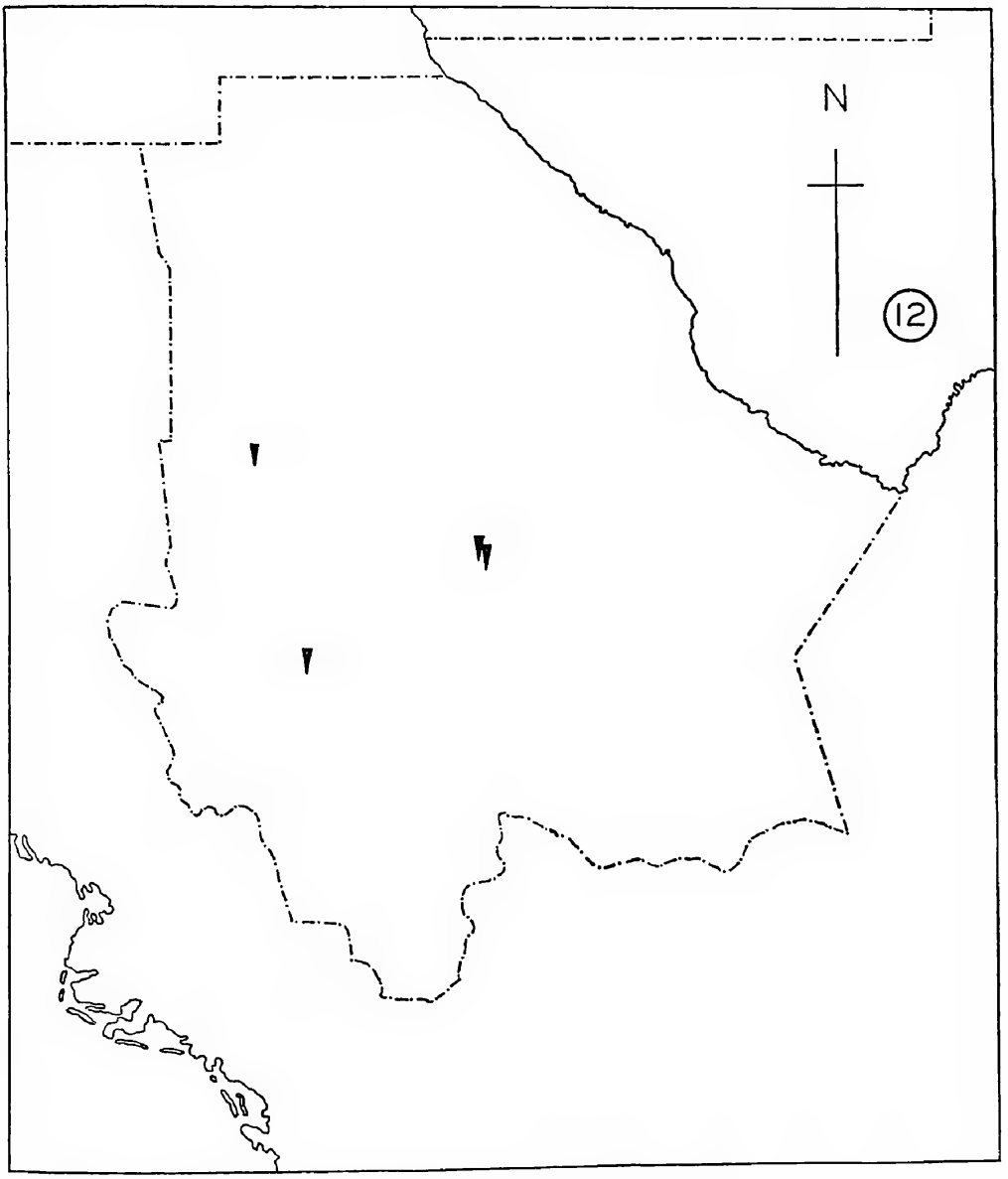
ASTRAGALUS sect. SCALARES (Jones), stat. nov., based on *Astragalus* sect. *Inflati* subsect. *Scalares* Jones, Rev. Astrag. 94, in clave. 1923.—Sp. typica: *A. scalaris* Wats.—Verosimiliter *Strigulosis* affines sed stipulis parvis inter se liberis caulem vix dimidium amplectentibus, praeterea ob caules paucos vel solitarium superne effuse ramosos necnon flores minimos valde numerosos laxissime racemosos habitu proprio insignes.

In the first instance *A. scalaris* was likened by Watson to *A. flexuosus,* but the plants have neither the buried root-crown nor the connate stipules of sect. *Scytocarpi* of which *A. flexuosus* is the prototype. The species was later assigned by Jones (1923, p. 107) to his sect. *Inflati* next to *A. Wardi,* and by Rydberg (1929, l.c.) to *Phaca* sect. *Microcystes*; but despite its small, somewhat inflated, unilocular fruit *A. scalaris* is anomalous in either group. The nearest match for the detached flower and pod of *A. scalaris* I can find in the genus are those of *A. pueblae* of sect. *Strigulosi,* and the very characteristic, paniculately branching but stiffly erect stems are also reminiscent of the same section. Although described as unilocular, the pod when carefully dissected sometimes shows a rudiment of septum near the base, an almost everpresent feature of the *Strigulosi,* most of which are, moreover, flowers of the summer and autumn months. It is suspected that *A. scalaris,* an isolated monotype, is derived from the *Strigulosi* or from some common precursor, from which it differs technically (inter alia) by its free stipules.

36. ASTRAGALUS SCALARIS

Erect, slender, graceful, proportionately tall, finely strigulose with straight, appressed hairs up to 0.2–0.4 mm. long, the green, striate stems becoming stramineous, the herbage green, the leaflets glabrous above; *stems* often solitary, rarely more than 3, stiffly and strictly erect from the superficial crown of a taproot, paniculately branched upward either from near the base or from near the middle, the branches either simple or again branched, all floriferous distally, the whole (2) 3–9 dm. tall; *stipules* submembranous, triangular or triangular-acuminate, 1.5–5 mm. long, decurrent around one-fourth to nearly half the stem's circumference; *leaves* (1.5) 3.5–13 cm. long, the lowest shortly petioled, the rest subsessile, with slender, tapering rachis and (11) 17–27 (31) slender-petiolulate, rather distant, linear-oblong, narrowly lance-elliptic, or more rarely oblong-ovate, thin-textured, flat, faintly penninerved leaflets (1.5) 3–13 mm. long, all retuse or some narrow ones obtuse and apiculate; *peduncles* erect or incurved-ascending, mostly very slender, 3–10 cm. long, either shorter or longer than the leaf; *racemes* very loosely or remotely 15–50-flowered (or the subterminal, depauperate ones only 5–10-flowered), the flowers spreading, the axis elongating, (2) 4–20 cm. long in fruit; *bracts* membranous, ovate-acuminate, narrowly triangular, or lanceolate, 0.7–2 mm. long; *pedicels* ascending, straight or arched outward in age, at anthesis slender, 0.7–1.5 mm. long, in fruit thickened, 0.8–2 mm. long; *bracteoles* 0; *calyx* 2.2–2.9 mm. strigulose with black hairs, the subsymmetric disc 0.4–0.6 mm. deep, the shallowly campanulate or hemispherical tube 1.6–2 mm. long, 1.7–2 mm. in diameter, the triangular or deltoid teeth 0.5–1 mm. long, the ventral pair shorter and broader than the rest, the orifice oblique, the

whole becoming papery, marcescent unruptured; *petals* pale pinkish-purple, or whitish distally purple-tinged, drying pallid or ochroleucous; *banner* recurved through ± 45°, broadly ovate-cuneate, shallowly notched, 5.2–6.4 mm. long, 3.6–4.8 mm. wide; *wings* 5–5.5 mm. long, the claws 1.6–1.9 mm., the oblong or oblong-oblanceolate, obtuse or truncate-emarginate, nearly straight blades 3.6–4.2 mm. long, 1.4–2.3 mm. wide; *keel* 3.9–4.7 mm. long, the claws 1.5–1.9 mm., the obliquely triangular-obovate blades 2.6–3 mm. long, 1.7–2.1 mm. wide, incurved through 85–95° to the blunt, deltoid apex; *anthers* 0.3–0.4 mm. long; *pod* horizontally spreading or declined, persistent on the receptacle, shortly stipitate, the stipe (0.4) 0.5–1.3 mm. long, concealed by the calyx, the body obliquely obovoid or half-obovoid, (4) 5–8 mm. long, 2.5–3.5 mm. in diameter, slightly inflated, broadly cuneate or rounded at base, abruptly contracted distally into a very short,



Map No. 12. Chihuahua. Range of *A. scalaris*.

broadly deltoid, slightly incurved, laterally flattened, minutely cuspidate beak, otherwise obtusely triquetrous, carinate ventrally by the straight or low-convex suture, openly and shallowly sulcate dorsally up to the base of the beak, the thin, green, glabrous valves becoming papery, stramineous, delicately reticulate, not inflexed or inflexed as a rudimentary septum up to 0.15 mm. wide; seeds brown, smooth, lustrous, 2–2.5 mm. long.—Collections: 7 (o); representative: *Pringle 1587* (G, NY, P, POM); *Townsend & Barber 433* (ARIZ, NY, US); *Pennell 18,933* (NY).

Streamsides and moist places in ravines, canyons, or open pine and oak forest, 6000–8000 (acc. Jones up to 9500) feet, known only from the Sierra Madre Occidental in Chihuahua.—Map No. 12.—August to October.

ASTRAGALUS SCALARIS (of a stairway or ladder, the allusion obscure) Wats. in Proc. Amer. Acad. 23: 270. 1888.—"By streams in the Sierra Madre, Chihuahua (no. 1220), September 1887."—Holotypus, collected September 23, 1887, by C. G. Pringle, GH! isotypi, K, ND, NY, PH, US!—*Phaca scalaris* (Wats.) Rydb. in N. Amer. Fl. 24: 361. 1929.

Astragalus scalaris var. *quercetinus* (of oak woods) Jones, Rev. Astrag. 107, Pl. 11. 1923. —"Sierra Madre, Chihuahua. San Diego canon, Sept. 16, 1903."—Holotypus, collected by M. E. Jones, POM! isotypi, GH, NY, US!

The Chihuahua milk-vetch, *A. scalaris,* is instantly recognized by its slender, strictly erect, airily branching stems which are often solitary and rarely more than three in number, by its rather numerous small leaflets, and by the remotely many-flowered racemes of tiny, purplish flowers followed by small, spreading, substipitate, turgid pods of obliquely obovoid form and devoid of all but a rudiment of septum. The few ovules and large seeds are other noteworthy features of this delicately delightful species. The plants vary a great deal in stature, some of those in the type-collection of var. *quercetinus* being nearly a meter tall, but there seems to be no good reason to recognize a variety which does not differ significantly in other respects. There is some doubt as to the duration of the root under average circumstances. Watson described *A. scalaris* as biennial, and some very slender individual plants appear to be flowering in their first season. Others, however, bear remnants of growth from preceding years, and the species must be at least potentially perennial. The meaning of the epithet *scalaris,* to which Watson gave no clue, remains an enigma.

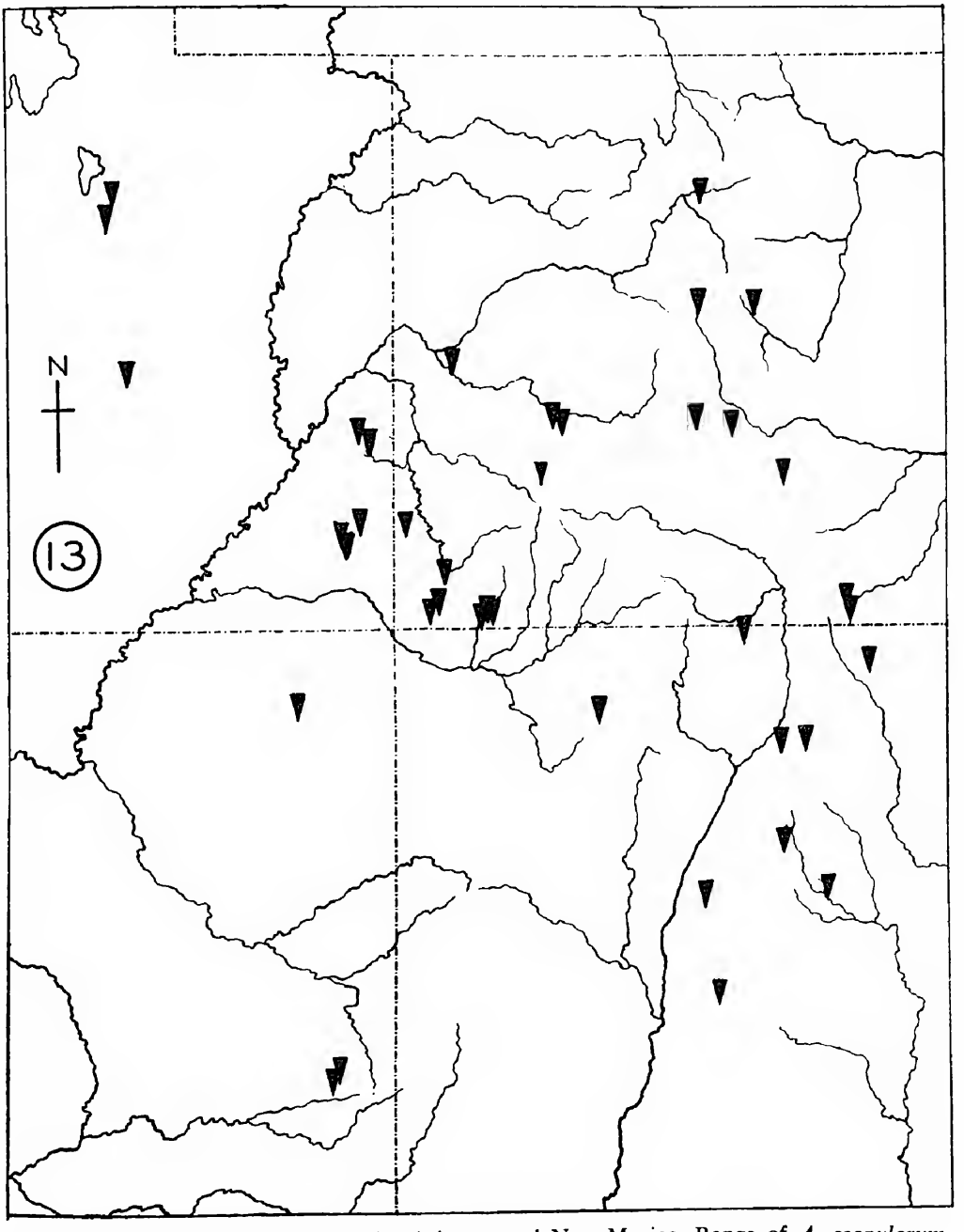
IX. Sectio TIOPSIDEI

Vigorous but diffuse, caulescent perennials, with taproot and buried root-crown or caudex; *vesture* basifixed; *stipules* toward the base of the stems and often of the lateral branches connate-amplexicaul; *leaves* imparipinnate, with 15–35 leaflets; *flowers* rather densely racemose, at full anthesis nodding and retrorsely imbricate, large, the moderately recurved banner about 18.5–23.5 mm. long; pedicels a little thickened in fruit, persistent; *calyx-tube* deeply campanulate or subcylindric; *petals* ochroleucous, regularly graduated, the keel-tip obtuse; *pod* pendulous, stipitate, persistent until dehiscence, the elongate, narrow body about 2.5–3.5 cm. long, lunately incurved or nearly straight, triquetrously compressed, fully bilocular; *dehiscence* apical and downward through the ventral suture, the walls of the septum also separating in age; *ovules* (17) 20–25.—Sp. 1, xerophyte, of the southern Rocky Mountains in Colorado and New Mexico, and sporadically west into eastern Arizona and central Utah.

ASTRAGALUS sect. TIOPSIDEI, sect. nov., *Strigulosis* ut videtur proxime affines, floribus magnis, tubo calycino profunde campanulato vel subcylindrico, et legumine (pendulo stipitato) acutiuscule triquetro absimiles.—Sp. unica: *A. scopulorum* Port.

Probably on account of the large, nodding, ochroleucous flowers, *A. scopulorum* has traditionally been associated with *A. Drummondii* and *A. racemosus,* by Jones (1923, p. 247) in sect. *Galegiformes* and by Rydberg (1929, p. 387; 1931 p. 398) in *Tium* sect. *Racemosa.* It differs from both in its diffuse stems arising from a subterranean root-crown and has, in con-

sequence, a quite different habit of growth. The seleniferous *A. racemosus* with its unilocular fruit is certainly not at all closely related to either of the other two, and *A. Drummondii,* with its remarkable hirsute vesture, stipules often (but not always) free, and fruit of thicker texture and much less sharply trigonous compression, is an equally isolated monotype. On the other hand *A. scopulorum* has almost every characteristic in common with the *Strigulosi,* considered collectively, except for the very large flowers and deeply campanulate calyx. There is no one species in that section closely related to *A. scopulorum;* it seems likely that its affinities are to be traced in the direction of *A. strigulosus* and its closer allies. The epithet *Tiopsidei* alludes to the likeness of the fruit to that of some free-stipuled *Miselli* such as *A. Howellii* which formed part of Rydberg's genus *Tium.*



Map No. 13. Parts of Utah, Colorado, Arizona, and New Mexico. Range of *A. scopulorum.*

37. Astragalus scopulorum

Of moderate stature, thinly strigulose with straight, filiform, appressed and subappressed hairs up to 0.5–0.75 mm. long, the stems usually purplish-brown, the herbage green, the leaflets somewhat bicolored, brighter green and glabrous above; *stems* several, decumbent and radiating, 1.5–4.5 dm. long, slender, simple, and subterranean for a space of 3–13 cm., thereafter becoming stouter and divaricately branched or upwardly bearing short, sterile, or depauperately fertile spurs in most of the axils, flexuous but not abruptly zigzag distally; *stipules* 3–9 mm. long, the subterranean ones pallid and scarious, the upper ones rather firm, the lowest of the stems and branches connate-amplexicaul into a stiffly papery, several-nerved, subtruncate or bidentate sheath, this sometimes ruptured by expansion of the stem, the median and upper ones mostly smaller, narrower, less strongly connate, the uppermost often free, with deltoid or lance-acuminate, acute or obtuse, erect or squarrose blades; *leaves* (1.5) 2.5–8 cm. long, the lowest shortly petioled, the rest subsessile, with (7) 15–29 (35) oval-oblong to linear-elliptic or oblanceolate, subacute, sharply acute, or rarely obtuse, flat or loosely folded leaflets (2) 4–18 mm. long; *peduncles* erect or incurved-ascending, 2.5–14 cm. long, a little shorter to much longer than the leaf; *racemes* (5) 10–22-flowered, rather dense at early anthesis, the declined or nodding flowers secund and retrorsely imbricated, the axis somewhat elongating, (1) 2–7 cm. long in fruit; *bracts* membranous or membranous-margined, lanceolate or lance-caudate, (1.5) 2–7 mm. long; *pedicels* at anthesis ascending and 1.5–2.5 (3) mm. long, in fruit arcuately spreading or straight and divergent, a little thickened, 2–4 mm. long; *bracteoles* 0–2; *calyx* (8) 9–11.5 (14) mm. long, strigulose with black or sometimes with some or all white hairs, the oblique disc 0.9–1.6 mm. deep, the deeply campanulate or subcylindric, pallid tube (6.5) 6.8–8.5 mm. long, 3.2–4.1 mm. in diameter, basally truncate and attached at the dorsal corner, sometimes a trifle saccate behind the pedicel, the subulate or lance-acuminate teeth 1.5–3.5 (6) mm. long; *petals* ochroleucous, the keel-tip sometimes faintly maculate; *banner* recurved through ± 45°, lance-oblong or rhombic-oblanceolate, 18.3–23.5 mm. long, 6–8.5 mm. wide; *wings* 16.4–19 mm. long, the claws 8.5–10.5 mm., the oblong-oblanceolate, obtuse, nearly straight or gently incurved blades 8.3–9.6 mm. long, 2.3–3.2 mm. wide; *keel* 13.6–15.4 mm. long, the claws 7.7–9.5 mm., the half-obovate or obliquely obovate blades 5.5–6.6 mm. long, 2.9–3.3 mm. wide, incurved through 80–95° to the deltoid apex; *anthers* 0.7–0.9 mm. long; *pod* pendulous, stipitate, the straight, slender stipe (4) 5–9 mm. long, the body linear-oblong, -elliptic, or -oblanceolate in profile, nearly straight or lunately incurved, (1.8) 2.5–3.5 cm. long, 3–6.5 mm. in diameter, cuneate at both ends or (when narrow) acuminately tapering downward into the stipe, cuspidate at apex, triquetrously compressed, with acute ventral and narrow but obtuse lateral angles, the lateral faces flat or low-convex, the slightly narrower dorsal face sulcate or shallowly concave, the thin, green, sometimes purple-speckled, glabrous valves becoming papery, greenish-stramineous or ultimately brown, transversely reticulate, inflexed as a complete septum 2–4 mm. wide; *seeds* brown, sometimes obscurely purple-dotted, smooth, lustrous, about 3–3.5 mm. long.—Collections: 41 (xi); representative: *Rydberg & Garrett 9152* (NY); *Rydberg & Vreeland 5981* (NY, WS); *Baker, Earle & Tracy 69* (ND, NY); *W. A. Weber 4752* (CAS, SMU, TEX, WS); *Ripley & Barneby 5329, 8329, 10,510* (CAS, RSA); *Barneby 12,618* (CAS, NY, RSA).

Gravelly clay flats and hillsides, in oak thickets, among sagebrush, in piñon or more rarely open pine forest, in soils of granitic or occasionally of basaltic or sedimentary origin, rather common and locally abundant at 6800–10,550 feet in the valleys of the Rocky Mountains from the upper Grand River and headwaters

of the South Platte in Colorado, south on both slopes of the Divide (but more common westward), to the Sandia and Manzano Mountains in northcentral New Mexico, west to the La Sal and Abajo Mountains in eastern Utah and the Black Mesa in northern Apache County, Arizona; apparently disjunctly, at 4800–5400 feet, along the upper forks of the Salt River in southern Apache and adjoining Gila Counties, Arizona; also local on the west slope of the Wasatch in central Utah (Salina Canyon, Sevier County; base of Mt. Nebo, Juab County; Thistle, Utah County).—Map No. 13.—May to August.

ASTRAGALUS SCOPULORUM (of craggy rocks, symbolizing the Rocky Mountains) Port. in Port. & Coult., Syn. Fl. Colo. 24. 1874.—"South Park, July 24, 1872, *Porter.* Wet Mountain Valley, 1873, *Brandegee,* in flower and fruit."—Cotypi, PH! isotypi *(Porter, Brandegee),* NY!—*Tragacantha scopulorum* (Port.) O. Kze., Rev. Gen. 948. 1891. *Tium scopulorum* (Port.) Rydb. in Bull. Torr. Club 32: 659. 1905.

Astragalus subcompressus (somewhat flattened, of the pod) Gray ap. Brand. in Bull. U. S. Geol. Surv. 2^3: 234. 1876.—"Animas Valley, 7000 feet altitude."—Holotypus, collected by *T. S. Brandegee, in 1875,* GH! isotypi, *Brandegee 1287,* UC!

Astragalus rasus (clean-shaven, the plants supposedly glabrous) Sheld. in Minn. Bot. Stud. 1: 158. 1894.—"Collected near Durango, Colo., June, 1891, by Miss Alice Eastwood, also on the Mesa Verde, southeast Colo., June, 1892, by Miss Alice Eastwood; and at Grand Junction, Colo., June, 1893, by De Alton Saunders."—Holotypus, the first cited, so labeled by Sheldon, MINN! paratypus *(Saunders),* NY!

Tium stenolobum (with narrow calyx-lobes) Rydb. in N. Amer. Fl. 24: 388. 1929.—"Type collected in the Sandia Mountains, on the eastern slope of Palomas, New Mexico, *Charlotte C. Ellis 326* . . ."—Holotypus, US! isotypi (2 sheets), NY!

The Rocky Mountain milk-vetch, *A. scopulorum,* is a handsome floriferous species, easily distinguished from others in the same range by the combination of stems arising from a buried root-crown and therefore naked except for stipular sheaths for a space of several centimeters below the first leaf, lower stipules united into a sheath, large, nodding, ochroleucous flowers, and pendulous, stipitate, trigonously compressed pods. The calyx-teeth vary in length from 1.5 to 6 mm., and the leaflets from obtuse to sharply acute, but the form with particularly long teeth and subacute leaflets described as *Tium stenolobum* is merely one of several minor variants of no taxonomic status. Among the isotypi of *T. stenolobum* at NY and US are plants with teeth only ± 3 mm. long, average for the species as a whole. Gray's *A. subcompressus,* described a second time in 1877 (in Proc. Amer. Acad. 12: 56), was no doubt proposed in ignorance of Porter's slightly earlier *A. scopulorum.* No such excuse can be made for *A. rasus,* distinguished by Sheldon by "the absence of pubescence," although he described the young leaves and stems as at least sometimes thinly hairy. The typus of *A. rasus* is a characteristic example of the Rocky Mountain milk-vetch which often appears almost or quite glabrous to the unaided eye.

The range of *A. scopulorum* outside the Rocky Mountains proper is scattered and discontinuous, and Jones believed the species to be a recent introduction in Utah. Subsequent collections from Utah and the disjunct but unquestionably natural occurrence of *A. scopulorum* on the Salt River in Arizona shows that Jones was probably mistaken on this point.

The Rocky Mountain milk-vetch was collected first by Dr. Parry in Middle Park, Colorado, in 1864 (US).

X. Sectio SCYTOCARPI

Caulescent, taprooted perennials, with subterranean root-crown or caudex, this rarely proliferating underground by means of adventitious roots; *vesture* basifixed; *stipules* dimorphic, the lowest connate, the upper ones free or nearly so; leaves imparipinnate, the leaflets mostly 9–27, rarely fewer, or (in subsect. *Wingatani*) sometimes decurrent or reduced in number; *flowers* loosely but sometimes shortly racemose, variably oriented, of small or moderate size, the banner 3.5–21 mm. long; *pedicels* persistent or tardily disjointing with the fruit; *calyx-tube* shallowly to deeply campanulate or subcylindric; *petals* purple, purplish, or whitish, regularly graduated, the banner recurved through 40–90°, the keel-tip either obtuse or acutely triangular; *pod* variable in orientation, outline, and compression, per-

sistent on the receptacle, sessile or stipitate, unilocular, the valves papery or leathery; *dehiscence* apical and sometimes downward through the length of the ventral suture, usually tardy; *ovules* 5–34.—Spp. 11, xerophytes, of the Great Plains, Rocky Mountains, and Colorado Basin, extending south through Arizona, New Mexico, and trans-Pecos Texas into northern Mexico.

The *Scytocarpi* form a large and taxonomically rather difficult group of species. The majority are innately variable as well as prolific in minor mutations, whereas several are sensitive to evolutionary pressures and have either already broken up, or are in process of differentiating into geographic races. The section is built up by accretion around a basic pattern set by *A. flexuosus* and its close allies, although these are not thought to be particularly primitive or in any immediate sense ancestral to the rest. While the outlying species which represent culminating divergences from the least specialized norm are remote from each other, all have retained clues to a common origin in the position of the root-crown relative to soil-level, in the connate lower stipules, and in the unilocular, persistent pod. The main body of the section, embracing subsects. *Scytocarpi, Antonini,* and *Halliani,* has been accepted traditionally as forming a natural group. To these I have added *A. gracilis,* very close in every respect to *A. flexuosus* except in the reduced size of the few-ovulate pod; three species with bladdery fruits formerly referred to sect. *Inflati* (or equivalent infrageneric category); and *A. wingatanus,* of which the laterally compressed pod suggests relationship with sect. *Ervoidei* but may be interpreted with equal probability as an independent and parallel modification. The *Scytocarpi* are closely related to sect. *Strigulosi,* a group of about the same size but of more southern range and distinguished technically by the nearly always partially or fully bilocular pod.

The center of dispersal and the area of greatest abundance of individuals and species lie in the southern Rocky Mountains, the adjoining foothills, and in outlying mountain masses in northern New Mexico and southern Colorado. A secondary area of speciation, coinciding with a greatly swollen fruit, has developed in the high deserts of southern Utah and Arizona.

The choice of *A. flexuosus* as lectotypus of the section deserves a word of comment. As originally circumscribed the *Scytocarpi* embraced nine species, marked off by defining phrases into four subsidiary groups, admittedly "inter se valde diversi." The first of these subgroups contained *A. Preussii* alone, a species anomalous in its context because of the long-stipitate pod. Gray consistently placed the aberrant elements first in a section, so *A. Preussii* may be safely discarded as a candidate for lectotypus. The second subgroup of three species consisted of *A. Chamaeleuce* and *A. tephrodes,* misplaced from sect. *Argophylli* which had been adequately defined on an earlier page of the Revision, and the annual *A. aridus,* remote from the remainder. The third group was limited to *A. sonorae,* again only distantly related to any other part of the *Scytocarpi* and ill-matching the sectional diagnosis. The last is a natural group of four species, *A. gracilentus* (= our *A. flexuosus* var. *Greenei*), *A. Fendleri* (= *A. flexuosus* fma.), *A. Hallii,* and *A. flexuosus* itself, which may reasonably be assumed to form the core of the section. Even though last in order of arrangement, *A. flexuosus* was by far the best-known and the first-described species, and is here adopted as lectotypus. Jones's sect. *Flexuosi* and Rydberg's genus *Pisophaca* were both based on the same and automatically become synonymous.

Key to the Subsections of Sect. Flexuosi

1. Flowers small, the campanulate or turbinate-campanulate calyx-tube 1.5–4 mm. long, the banner 5.3–11 mm., the keel 3.5–8.9 mm. long (2)
   2. Pod small, 4–8 (9) mm. long, strigulose, more or less prominently rugulose-reticulate transversely; *calyx* (including the teeth) 2.1–3.3 mm. long; *ovules* 5–9; Great Plains, Montana to Saskatchewan, s. to n.-w. Texas ..... X (iii). Subsect. *Microlobi*
   2. Pod larger and ovules 10 or more, or if the pod as small and as few-ovulate then glabrous, and plants of the Colorado Basin; *pod* in any case only faintly reticulate, not rugulose; *calyx,* in the range of the preceding, 3.5–4.8 mm. long (3)
      3. Pod terete or dorsiventrally compressed, flattened or grooved dorsally when less than 5 mm. in diameter ..... X (i). Subsect. *Scytocarpi*
      3. Pod laterally compressed, 2-sided (6–15 mm. long, 3–4.5 mm. in diameter, mostly 5–8-ovulate) ..... X (ii). Subsect. *Wingatani*
1. Flowers larger, the deeply campanulate or subcylindric calyx-tube 4.5–8 mm. long, the banner 13–21 mm., the keel 9–14 mm. long (4)
   4. Pod ascending on straight pedicels from ascending racemes; *flowers* ascending, even in age; *calyx* relatively narrow, the tube about 2–3 (3.4) mm. in diameter; n. Mexico ..... X (iv). Subsect. *Antonini*

4. Pod spreading or declined on curved or divaricate pedicels or, if ascending or erect, then humistrate from decumbent peduncles; *calyx* broader, the tube (2.9) 3.1–4.6 mm. in diameter; New Mexico and Arizona to Colorado and w. Oklahoma ..... X (v). Subsect. *Halliani*

X (i). Subsectio Scytocarpi

General characters of the section; *flowers* small, spreading or declined in age, the keel about 5–9 mm. long; *calyx-tube* campanulate; *pod* deflexed, declined, or horizontally spreading, sessile or shortly stipitate, linear, oblong, elliptic, ovate, or subglobose in outline, more or less obcompressed, scarcely tumid to distinctly and sometimes greatly inflated, the valves papery, reticulate but not rugulose; *ovules* 6–32.—Spp. 6, nearly coextensive in range with the whole section.

Astragalus sect. Scytocarpi (with leathery pods) Gray in Proc. Amer. Acad. 6: 222, pro parte, 1864.—Sp. lectotypica: *A. flexuosus* (Hook.) Don.

Astragalus sect. *Flexuosi* Jones, Rev. Astrag. 192. 1923.—Sp. typica: *A. flexuosus* (Hook.) Don.—*Pisophaca* sect. *Flexuosae* (Jones) Rydb. in N. Amer. Fl. 24: 323. 1929.

Pisophaca Rydb. in N. Amer. Fl. 24: 322. 1929.—Generitypus: *P. flexuosa* (Hook.) Rydb. = *A. flexuosus* (Hook.) Don.—*Astragalus* subgen. *Pisophaca* (Rydb.) Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 205. 1941.

The present subsect. *Scytocarpi* is equivalent to Rydberg's *Flexuosae* if deprived of the free-stipuled *A. (Lonchocarpi) pinonis* and at the same time extended to admit three species with more or less swollen or truly bladdery fruits. These inflated *Scytocarpi* have been referred in the past to *Phaca* or to sect. *Inflati*, but differ in their subterranean root-crown, connate lower stipules, and emmenoloboid pod. The link between them and the more ordinary type is provided by *A. flexuosus* var. *Greenei* in which the pod varies from only a little turgid to very decidedly inflated.

Key to the Species of Subsect. Scytocarpi

1. Leaflets (9) 11–25; *pod* pubescent or rarely glabrous, (10) 14–25-ovulate; *banner* 7–11 mm. long, well over 7 mm. long when the ovary and pod are glabrous (2)
   2. Pod linear, linear-oblong, or -oblanceolate, or lance-elliptic in profile, commonly not or scarcely inflated and less than 7 mm. in diameter, but if decidedly inflated and ovoid or ovoid-ellipsoid up to 9 mm. in diameter (as in *A. flexuosus* var. *Greenei*), then the valves not mottled, the banner over 9 mm. long, and the range different from the next (3)
      3. Stems aerial for a space of 1–6 dm., the subterranean, leafless part (1–20 cm. long) nearly always much shorter; *caudex-branches* not (or only very rarely and weakly) rooting at the nodes, the adventitious rootlets in any case not persisting or giving rise to offsets at a distance from the parent plant, the stems thus all arising together from one caudex ..... 38. *A. flexuosus*
      3. Stems aerial for a space of 1.5–5 cm., the subterranean part (mostly 3–40 cm. long) as long or commonly longer; *caudex-branches* (of mature plants) widely creeping, rooting at some buried nodes, and with some adventitious rootlets ultimately developing into independent taproots and giving rise to stems at a distance from the parent plant ..... 39. *A. pictiformis*
   2. Pod obliquely ellipsoid, broadly ellipsoid, or subglobose, greatly inflated, 7–22 mm. in diameter, the valves brightly red- or purple-mottled; *banner* 6.2–9 mm. long; n. Arizona, s. Utah, and adjoining Nevada and New Mexico (4)
      4. Calyces and stems silvery-canescent with straight, appressed hairs; *pod* appressed-strigulose, 1.2–2.2 cm. in diameter; *keel-tip* triangular, beaklike; *ovules* 21–32; n.-e. Arizona, s.-e. Utah, and adjoining New Mexico ..... 41. *A. fucatus*
      4. Calyces and stems villosulous or loosely strigulose with sinuously incurved, widely spreading, or retrorse hairs; *pod* loosely strigulose or villosulous, 6–13 mm. in diameter; *keel-tip* deltoid, obtuse; *ovules* 10–20; s.-w. Utah, n.-w. Arizona, and adjoining Nevada ..... 42. *A. subcinereus*
1. Leaflets 7–11; *pod* glabrous, 6–10-ovulate; *banner* 6–7 mm. long; n.-w. New Mexico and s.-w. Colorado ..... 40. *A. proximus*

38. Astragalus flexuosus

Usually quite slender, sometimes tall, strigulose or villosulous with straight and appressed, incurved-ascending, or more rarely spreading hairs up to 0.2–0.6

(0.7) mm. long, the herbage greenish, cinereous, or silky-canescent, the leaflets bicolored, above yellowish-green and less densely pubescent or often glabrous; *stems* decumbent with ascending tips or weakly incurved-ascending to assurgent, (1) 1.5–6 dm. long, simple, slender, and subterranean for a space of 1–20 cm. (rarely exposed by erosion), commonly branched or spurred at the first aerial nodes, or at least from 1–several nodes preceding the first peduncle, often purplish at base, flexuous or zigzag distally; *stipules* (1) 1.5–7 mm. long, the lowest amplexicaul and connate into a campanulate, truncate or shortly bidentate, papery, brownish, purplish, or pallid sheath, the upper ones mostly longer, triangular to lance-acuminate, connate at base only or nearly free, the herbaceous blades commonly deflexed; *leaves* (1.5) 2–9 cm. long, the lowest shortly petioled, the upper ones subsessile, with (9) 11–25 linear, narrowly oblong, or oblong-oblanceolate, more rarely (in some lower, exceptionally all leaves) broadly oblong, obovate-cuneate, or obcordate, obtuse, truncate, or retuse, folded or sometimes flat leaflets (2) 3–19 mm. long; *peduncles* incurved-ascending or sometimes straight and divaricate, or erect, 1.5–13.5 cm. long, shorter or longer than the leaf; *racemes* loosely (7) 10–30-flowered, the axis elongating, (1) 2.5–13 cm. long in fruit; *bracts* submembranous, ovate or lance-acuminate, 0.6–4.5 mm. long; *pedicels* at anthesis 0.7–1.5 mm. long, in fruit becoming strongly arched outward, or geniculate at base and divaricate, somewhat thickened, 1.5–3.5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 3.3–6 mm. long, strigulose-pilosulous with white, mixed black and white, or all black hairs, the subsymmetric or oblique disc 0.4–1 (1.3) mm. deep, the tube 2.4–4.2 mm. long, 1.8–2.9 mm. in diameter, the subulate or triangular-subulate teeth 0.5–2 mm. long; *petals* varying from whitish or creamy to lively purple, nearly always suffused distally with some shade of lilac; *banner* recurved through 45–90°, ovate-cuneate or rhombic-obovate, deeply or shallowly notched, 7.2–11 mm. long, 4.4–7.8 mm. wide; *wings* 6.9–10.5 mm. long, the claws (2) 2.4–4.2 mm., the narrowly oblong, oblong-elliptic or -oblanceolate, obtuse or emarginate, nearly straight or lunately incurved blades 5–7.9 mm. long, 1.7–2.9 mm. wide; *keel* 5–8.2 mm. long, the claws 2.2–3.9 mm., the half-obovate, obliquely obovate, or rarely half-circular blades 2.6–5.1 mm. long, 1.8–2.7 mm. wide, incurved through 90–120° to the bluntly or sharply deltoid, rarely minutely porrect apex; *anthers* 0.3–0.65 (0.8) mm. long; *pod* pendulous (from erect axes) or spreading (from horizontal axes), sessile or substipitate, the stipe up to 1.3 mm. long but commonly less, the body varying from linear-oblong or -oblanceolate to elliptic, oblong-, or ovate-elliptic in profile, (8) 11–24 mm. long, 2.7–9 mm. in diameter, either straight or gently in- or decurved, ± obcompressed and often shallowly sulcate dorsally (or when broad also ventrally), the thinly fleshy valves either green or mottled, becoming thinly to stiffly papery and brownish or stramineous, finely reticulate, thinly to densely strigulose, villosulous, or rarely glabrous; *dehiscence* apical and downward through the ventral suture, the valves gaping distally or somewhat twisted-recurved; *ovules* (12) 14–25; *seeds* pale or dark brown, olivaceous, or blackish, sometimes purple-speckled, pitted or nearly smooth 1.9–3 mm. long.

The pliant milk-vetch, *A. flexuosus*, is a polymorphic aggregate of many small races minutely distinguishable from one another at the extreme point of their development, but fully intergradient and therefore not definable in mutually exclusive terms. During the preliminary studies I attempted to maintain *A. gracilentus* and *A. Greenei* together as a species coordinate with *A. flexuosus* and differing in the turgid or decidedly inflated pod of nearly always broader outline. But a full series of variants between the linear or linear-oblanceolate pod of *A. flexuosus* and the broader, plumper one of *A. Greenei* exists in nature. Jones considered his *A. Diehlii* as little more than "an extreme form of *A. flexuosus*," and the pod is scarcely distinguishable from that of some forms of "*A. gracilentus*" lately obtained in the type-region

near Santa Fe. The old *Phaca Fendleri* and *P. elongata,* as well as Rydberg's more modern *Pisophaca ratonensis, P. sierrae-blancae, P. Saundersii,* and *P. stictocarpa,* all fit readily into the present concept of *A. flexuosus* and are discussed below under the heading of minor variants.

Key to the Varieties of A. flexuosus

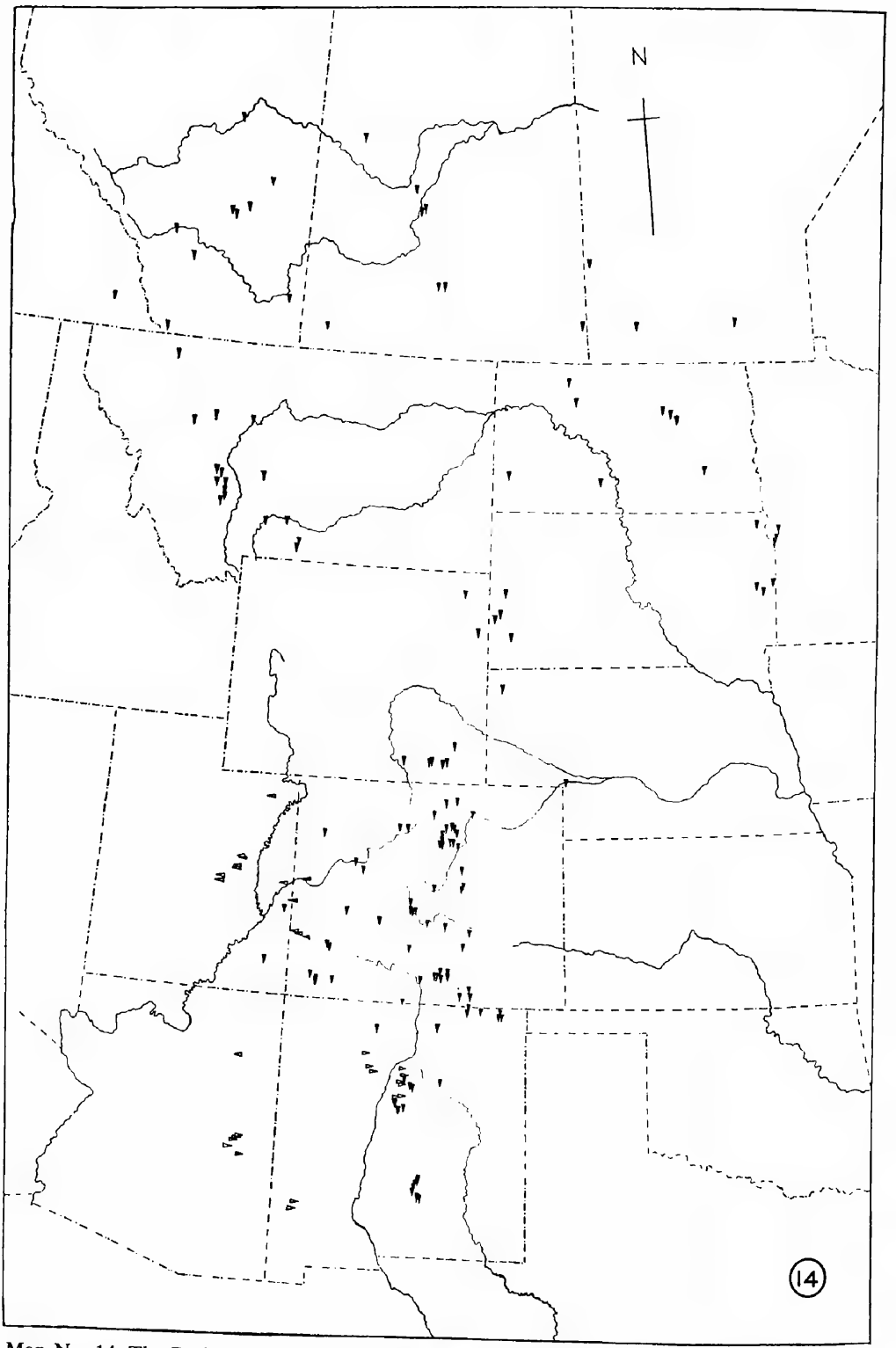
1. Calyx 3.5–6 mm. long; *banner* at full anthesis recurved through ± 45–50°, sometimes further in withering; *keel* 5.3–8.2 mm. long, the blades half-obovate, 3.4–5.2 long, incurved through 90–100°; widespread from e.-centr. Arizona and n. Mexico n. through the Rocky Mountains and higher plains to s. Canada and Minnesota, but on the w. slope in Colorado mostly above 6000 ft. elevation (2)
   2. Pod subsessile or very shortly stipitate, nearly always cuneately tapering at base, scarcely turgid, 2.7–4.8 mm. in diameter; centr. New Mexico n.-ward ..... 38a. var. *flexuosus*
   2. Pod sessile or nearly so, turgid or decidedly inflated, (4) 5–9 mm. in diameter, when less than 5 mm. in diameter rounded at base; n.-centr. and n.-w. New Mexico and e.-centr. Arizona s.-ward ..... 38b. var. *Greenei*
1. Calyx 3.3–4.1 mm. long; *banner* abruptly recurved through ± 90°; *keel* 5–5.5 mm. long, the half-circular blades very strongly incurved through ± 120°; Colorado Basin, e. Utah, and adjoining Colorado and Arizona, mostly below 6000 ft. elevation. Pod 11–15 mm. long, 3–4 (4.5) mm. in diameter ..... 38c. var. *Diehlii*

38a. Astragalus flexuosus var. flexuosus

Stems 1.5–6 cm. long; *herbage* greenish or silky-canescent, the vesture appressed, ascending, or rarely incurved; *leaflets* 11–25 (29), mostly linear or narrowly oblong-oblanceolate; *peduncles* 4–19 cm. long; racemes (7) 12–26 (30)-flowered, the axis 3–13 cm. long in fruit; *calyx* 3.5–5.8 long, the tube 2.7–4.3 mm. long, 1.8–2.9 mm. in diameter, the teeth 0.5–1.7 mm. long; *banner* 7.4–11 mm. long; *wings* 7.3–10.5 mm. long, the claws 2.6–4.2 mm., the blades 5.3–7.9 mm. long, 1.7–2.7 mm. wide; *keel* 5.3–7.5 mm. long, the claws 2.3–3.9 mm., the blades 3.4–4.3 mm. long, 1.8–2.4 mm. wide; *pod* stipitate or subsessile, the stipe 0.5–1.3 mm. long, concealed by the marcescent calyx, the body linear-oblong, -oblanceolate, or narrowly oblong-elliptic in profile, (8) 12–24 mm. long, 2.7–4.8 mm. in diameter, straight, gently incurved, or very rarely a trifle decurved, flattened or very shallowly sulcate dorsally, finely strigulose, villosulous, or rarely glabrous, mottled or not; *ovules* 14–20.—Collections: 163 (xvi); representative: *Macoun & Herriott 70,490* (ND, NY): *Hitchcock & Muhlick 11,800* (CAS, NY, RSA, WS); *W. A. Weber 5681* (CAS, SMU, TEX); *Ripley & Barneby 10,176* (CAS, RSA); *A. & E. Heller 3783* (NY, WS).

Grassy hills and stony knolls on the prairies, open gravelly banks, abandoned sandy fields, cobblestone river bluffs, canyon floors and terraces, in grassland, about oak thickets, in piñon-juniper woodland, ascending (southward) into yellow pine forest, 2200–9300 feet, common and locally abundant in the southern Rocky Mountains from southeastern Wyoming to northcentral New Mexico, in Colorado on both slopes of the Continental Divide but rarer westward, reaching just into southeastern Utah (Abajo Mountains); White and Sacramento Mountains, southcentral New Mexico; Black Hills, South Dakota; again common in the eastern foothills of the Rocky Mountains in Montana and southern Alberta, and thence east, apparently interruptedly, across the plains to southwestern Manitoba, North Dakota, the upper Sioux River in eastern South Dakota, the Minnesota River in westcentral Minnesota, and western Nebraska; southeastern British Columbia (probably introduced, fide J. M. Calder, in litt.).—Map No. 14.—May to August, continuing into late September in summer-rainfall areas of New Mexico.

Astragalus flexuosus (Hook.) Don, Gen. Hist. Dichl. Pl. 2: 256. 1832, published independently of but exactly synonymous with *Phaca flexuosa* (pliant) Hook., Fl. Bor.-Amer. 1: 141. 1831.—"Abundant on elevated and dry fertile soils of the Red River and Assiniboin,



Map No. 14. The Prairie and Rocky Mountain States and Provinces, westcentral United States and southern Canada. Range of *A. flexuosus*: ▼ var. *flexuosus*; ◊ *Greenei;* and ◊ var. *Diehlii.*

lat. 50°. *Douglas.*"—Holotypus, labeled "Red River and at Lake Travers, *Douglas.*," K! isotypus, dated 1827, BM!—Don's specimen, supposedly from "Near the Columbia River," presumably in herb. Lambert., not located.—*Tragacantha flexuosa* (Hook.) O. Kze., Rev. Gen. 945. 1891. *Homalobus flexuosus* (Hook.) Rydb. in Bull. Torr. Club 32: 666. 1905. *Pisophaca flexuosa* (Hook.) Rydb. in N. Amer. Fl. 24: 324. 1929.

Astragalus flexuosus var. *albus* (white, of the flowers) Dougl. ex Don, l.c. 1832 *("alba").* —No locality given.—Don's specimen, formerly in herb. Lambert., not located; isotypi, labeled "*A. flexuosus* β *alba* Dougl.," BM, K!

Phaca elongata (elongate, of the pod) Hook., Fl. Bor.-Amer. 1: 140. 1831.—"Plains of the Saskatchewan. *Dr. Richardson* . . . "—No Richardson spm. found at K in 1962; presumed isotypus, labeled "*Phaca elongata,* Franklin Expedition, W. J. Hooker ex herb. Short.," PH!—*A. flexuosus* var. *elongatus* (Hook.) Jones, Contrib. West. Bot. 10: 58. 1902. *Pisophaca elongata* (Hook.) Rydb. in N. Amer. Fl. 24: 325. 1929.

Phaca elongata β *minor* (smaller) Hook., Fl. Bor.-Amer. 1: 140. 1831.—"Plains of the Saskatchewan . . . *Drummond.*"—Holotypus, K!

Phaca Fendleri (August Fendler, 1813–1883, pioneer plant collector in s.-w. United States, etc.) Gray in Mem. Amer. Acad. II, 4 (Pl. Fendl.): 36. 1849.—"Woodlands, in the mountains, between Santa Fe and Pecos, August, 1847. No. 157."—Holotypus, *Fendler 157,* GH! isotypus, MO!—*Astragalus Fendleri* (Gray) Gray in Pl. Wright. 2: 44. 1853. *Tragacantha Fendleri* (Gray) O. Kze., Rev. Gen. 944. 1891. *A. flexuosus* var. *Fendleri* (Gray) Jones, Contrib. West. Bot. 10: 62. 1902. *Homalobus Fendleri* (Gray) Rydb. in Bull. Torr. Club 32: 667. 1905.

Pisophaca sierrae-blancae (of Sierra Blanca, or White Mountains) Rydb. in N. Amer. Fl. 24: 323. 1929 *("Sierrae-Blancae").*—"Type collected in the White Mountains, Lincoln County, New Mexico, July 26, 1897, *E. O. Wooton 213.*"—Holotypus, NY! isotypi ND, NMC!—*A. flexuosus* var. *sierrae-blancae* (Rydb.) Barneby in Leafl. West. Bot. 4: 54. 1944.

Pisophaca ratonensis (of Raton, New Mexico) Rydb. in N. Amer. Fl. 24: 324. 1929.—"Type collected at Des Moines, Union County, New Mexico, June 14, 1924, *Eggleston 20114* . . . "—Holotypus, NY! isotypus, CAS!

Pisophaca Saundersii (De Alton Saunders, 1870– , author of papers on the botany of South Dakota) Rydb. in N. Amer. Fl. 24: 328. 1929.—"Type collected at Glenwood Springs, Colorado, June 11, 1893, *D. A. Saunders D.*"—Holotypus, MINN! isotypus (fragm.), NY!

Processes of racial differentiation are clearly at work in var. *flexuosus* as defined in these pages, but have not reached a point at which segregates can be described in terms of substantial morphological characters. Two relatively distinct phases can be discerned in the material seen from Colorado and New Mexico. One, var. *Fendleri* sensu Jones (1923, p. 194), is a relatively slender plant with short, pallid-puberulent calyx ± 3.5–4 mm. long and small, pale flowers with banner ± 7.5–9.5 mm. long. The other is more robust in general growth-habit and has a slightly longer, commonly black-hairy calyx and bright purple flowers with banner 9.5–11 mm. long. The first is found at middle altitudes in the mountains, on both slopes of the Divide but more strongly marked westward; the second is most common on the higher prairies and foothills drained by the Arkansas, Canadian, and Pecos Rivers and the Rio Grande. Toward its northern limit var. *flexuosus* tends to become more densely silky as to calyx and herbage, but is not invariably so; and variation in size of the calyx and corolla and, to a less extent, in color of the calyx-hairs and petals, nearly spans the range exhibited by the two southern forms collectively. It is sometimes possible to predict without help from the label the approximate provenance of a given specimen—a good proof of the existence within the variety of genuine geographic trends; but no practical method of defining the minor variants has been discovered. The six following are the most likely to attract attention:

M. v. 1. Calyx white-silky; *petals* lilac or pale purple; *pod* usually elongate, 14–23 mm. long.—Range of the species, except for the s.-w. corner of Colorado and adjoining New Mexico (= *A. flexuosus,* sens. strict.).

M. v. 2. Similar, but petals white. An uncommon albinistic mutant (presumably = var. *alba* Dougl. ex Don).

M. v. 3. Like M. v. 1, but pod gently incurved.—N. Colorado n.-ward (= *Phaca elongata* Hook.).

M. v. 4. Robust; *leaflets* of lower leaves often broadly oblong or obcordate; *herbage* usually green; *calyx* 4.2–5 mm. long, black-hairy; *petals* bright purple, the banner mostly 9.5–11 mm. long; *pod* 1.3–2.4 cm. long, often mottled.—N.-e. New Mexico and n. to the Arkansas Valley in Colorado (= *Phaca Fendleri* Gray; *Pisophaca ratonensis* Rydb.).

M. v. 5. Similar, but pod glabrous.—White and Sacramento Mountains, New Mexico, where common, but occurring with the pubescent-fruiting form (= *Pisophaca sierrae-blancae*).

M. v. 6. Slender; *stems* and herbage dark green; *calyx* pale puberulent, 3.5–4 mm. long;

petals whitish or pale lilac, the banner 7.5–9.5 mm. long; *pod* more thinly papery, especially when fully ripe, (8) 12–15 (18) mm. long, thinly puberulent or glabrous.—Rocky Mountains of Colorado, extending into n.-w. New Mexico and s.-e. Utah (= *Pisophaca Saundersii*, approximately).

38b. Astragalus flexuosus var. Greenei

Habit of var. *flexuosus*, the stems 1.5–4 dm. long, the herbage greenish-cinereous, the vesture appressed, incurved-ascending, rarely spreading-pilosulous; *leaflets* (9) 13–23, linear-oblong to obovate-cuneate; *peduncles* 1.5–13.5 cm. long; *racemes* (7) 10–30-flowered, the axis (1) 2.5–10 cm. long in fruit; *calyx* 3.5–6 mm. long, the tube 2.8–4.2 mm. long, 2.2–2.8 mm. in diameter, the teeth 0.7–2 mm. long; *banner* 9–10.8 mm. long; *wings* 8.6–9.6 mm. long, the claws 3.4–4 mm., the blades 5.6–6.8 mm. long, 1.9–2.9 mm. wide; keel 7–8.2 mm. long, the claws 3–4.1 mm., the blades 4–5.3 mm. long, 2–2.7 mm. wide; *pod* sessile or nearly so, the stipe not over 0.5 mm. long and hardly longer than wide, the body turgid or decidedly inflated, lance-ellipsoid to plumpy ellipsoid, oblong- or ovoid-ellipsoid, (12) 14–23 mm. long, (4) 5–9 mm. in diameter, straight or slightly in- or decurved, shallowly sulcate dorsally when narrow and both ventrally and dorsally when broad, when narrow the ventral suture prominent, the strigulose or villosulous valves not or sometimes brightly mottled; *ovules* 16–25.—Collections: 19 (viii); representative: *Barneby 12,634* (CAS, NY, RSA, US); *Ripley & Barneby 8355* (CAS, GH, NY, RM, RSA, UTC); *Barneby 11,187* (CAS, NY, RSA).

Gullied badlands, dry knolls, bluffs and hilltops, with piñon and juniper, or sometimes in oak chaparral, 4400–7400 feet, locally plentiful in two somewhat disjunct areas: upper Rio Grande Valley in Santa Fe and Sandoval Counties, New Mexico; upper Salt and Gila Valleys in Gila County, Arizona, and western Grant County, New Mexico.—Map No. 14.—April to June.

Astragalus flexuosus var. Greenei (Gray) Barneby in Leafl. West. Bot. **9**: 91. 1960, based on *A. Greenei* (Edward Lee Greene, 1842–1915, voluminous writer on botany and botanical literature) Gray in Proc. Amer. Acad. **16**: 105. 1880.—"Foothills of the Mogollon Mountains, New Mexico, April 20, 1880, E. L. Greene."—Holotypus, GH! The type collection was distributed by Greene mixed with a second gathering, made in September of the same year in the Mimbres Mountains. This second element represents the summer-flowering *A. Hallii* var. *fallax* and has caused much confusion. The sheet in herb. Greene. (ND) labeled "*A. Greenei*. Mimbres, Sept. 22, 1880" is largely var. *fallax*, but contains a fragment of the true species. One sheet at NY, labeled "Mogollon Mountains, April 10 (or 16), 1880," of which a Stanford University photograph has been distributed, is another mixture; the photographic enlargements show the flowering raceme of *A. Greenei* and the fruits of var. *fallax*. A duplicate (NY) bears additional data: "Duck Creek"; isotypus, dated April 17, 1880, K!— *A. gracilentus* var. *Greenei* (Gray) Jones, Contrib. West. Bot. **8**: 14. 1898. *Pisophaca Greenei* (Gray) Rydb. in N. Amer. Fl. **24**: 327. 1929.

Phaca gracilenta (slender) Gray in Mem. Amer. Acad. II, 4 (Pl. Fendl.): 36. 1849.—"Bare, rocky hills, Santa Fe, April to June. 159."—Holotypus *(Fendler 159)*, GH! isotypi, BM, K, MO, PH!—*Astragalus gracilentus* (Gray) Gray in Proc. Amer. Acad. **6**: 223. 1864. *Tragacantha gracilenta* (Gray) O. Kze., Rev. Gen. 945. 1891. *Pisophaca gracilenta* (Gray) Rydb. in N. Amer. Fl. **24**: 327. 1929.

Pisophaca stictocarpa (with spotted pods) Rydb. in N. Amer. Fl. **24**: 328. 1929.—"Type collected on hills at Sante Fe, New Mexico, May 28, 1897, *Heller, 3606* . . . "—Holotypus (collected by A. A. and E. G. Heller), NY! isotypi, MO, ND, P, US!—*Astragalus stictocarpus* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. **50**: 21. 1937.

The original descriptions of *P. gracilenta* and *A. Greenei* were drawn up from single specimens differing a good deal in size and inflation of the pod, and it is easy to understand how they have been maintained, either as species or varieties, by subsequent botanists. In northern Santa Fe County, where Fendler first met with it, *P. gracilenta* is locally abundant on sandy hills and sedimentary badlands, and the pod in this region is usually narrow and little swollen, mostly 4–5 mm., exceptionally up to 7 mm. in diameter, although it varies in outline and

curvature. Along Rio Salado in Sandoval County, about fifty miles west of Santa Fe, a similar plant is found on bluffs and hillsides among junipers, and the pod here varies from about 4.5 to 6.5 mm. in diameter. A short distance westward, near the Rio Grande-San Juan watershed, the pod becomes decidely inflated and up to 7.5 mm. in diameter. These populations seem to represent one natural biological entity, *A. gracilentus* in the strict sense.

In the foothills of the Mogollon Mountains near the head of the Gila River, *A. Greenei,* which differs from *P. gracilenta* in no perceptible habital or floral character, presents a plumper, decidedly inflated pod 6–10 mm. in diameter, at first sight quite distinct in form. However in the Salt River drainage in Gila County, Arizona, otherwise identical plants exhibit great variation in the fruit, the most swollen examples being an exact match for *A. Greenei,* while the narrower forms agree precisely with some collections from the Rio Grande. It seems probable that the populations in the two main areas of dispersal are evolving in divergent directions and are already statistically different; but so long as they continue to produce a proportion of individuals which cannot be told apart, they cannot claim taxonomic recognition.

Over its whole range var. *Greenei* is very changeable in orientation of the pubescence, which often varies from one plant to the next in a colony. Plants with strigulose and with villosulous leaves, pods, or both, are found in close proximity near Santa Fe and also on the Natanes Plateau in Arizona. The typus of *P. stictocarpa* which came, like that of *P. gracilenta,* from Santa Fe, represents the form with subvillosulous fruits.

The descriptions of *A. Greenei* given by Jones (1923, p. 195, as *A. gracilentus* var.) and by Rydberg (1929, p. 327, as *Pisophaca*) are incorrect in important particulars. Both call for a pod about 1 cm. or more in diameter, and Jones has the flower 1.5–2 cm. long. These errors arose from the mixture of two species distributed by Greene under the label of *A. Greenei,* as already mentioned in the synonymy above. Jones specifically drew attention to the mixed nature of Greene's material, but apparently transferred the epithet and concept to the element representing *A. Hallii* var. *fallax.*

It is possible that var. *Greenei* extends farther southward than suggested by the map. A flowering specimen from Zacatecas, (southwest of El Sauz, *M. S. Johnston 2661A,* RSA), certainly belonging in subsect. *Scytocarpi* and probably to the species *A. flexuosus,* is quite suggestive of var. *Greenei.* It cannot be identified exactly without the fruit.

38c. Astragalus flexuosus var. Diehlii

Closely resembling forms of var. *Greenei* with narrow pods; *stems* (1) 1.5–3 dm. long, often wiry and zigzag distally; *herbage* greenish-cinereous, the vesture truly appressed (rarely a very few ascending hairs); *leaflets* (7) 11–17, mostly linear or narrowly oblong-oblanceolate; *peduncles* 2.5–6 cm. long; *racemes* 12–26-flowered, the axis 2.5–9.5 cm. long in fruit; *calyx* 3.3–4.1 mm. long, the tube 2.4–2.7 mm. long, 1.9–2.3 mm. in diameter, the teeth 0.7–1.1 (1.4) mm. long; *petals* pale lilac, all more strongly incurved than in the preceding vars.; *banner* 7–9 mm. long; *wings* 6.8–8.2 mm. long, the blades 5–5.7 mm. long, 1.8–2.5 mm. wide; *keel* 5–5.5 mm. long, the claws 2.2–2.6 mm., the blades 2.6–3.3 mm. long, 2–2.2 mm. wide, very strongly incurved to the deltoid, often minutely porrect apex; *pod* sessile, narrowly oblong-ellipsoid, straight or a trifle in- or decurved, often a little compressed laterally but ± flattened dorsally, carinate by the prominent ventral suture, the strigulose valves mottled or not; *ovules* 12–18.—Collections: 12 (v); representative: *Holmgren 7953* (CAS, UTC, WS); *Ripley & Barneby 4732* (CAS, NY, RSA), *5424* (CAS, RSA); *Barneby 13,047* (CAS, NY, RSA).

Low hills, desert flats, canyon floors and washes, in loose sandy soils derived from sandstone, 4500–5500 feet, locally plentiful in the Colorado Basin from San Rafael Swell and Price River Valley east around the foot of the Tavaputs Escarpment to the lower Grand and Dolores Rivers, eastcentral Utah and western Colorado, and apparently somewhat isolated in the Uinta Basin near Vernal, Utah, and near the head of Oraibi Wash in Navajo County, Arizona.—Map No. 14.—Late April to June.

Astragalus flexuosus var. Diehlii (Jones) Barneby in Leafl. West. Bot. 4: 54. 1944, based on *A. Diehlii* (I. E. Diehl, a correspondent of Jones) Jones, Rev. Astrag. 194, Pl. 43. 1923.—"Adobe plains at Farnham Utah as to the type."—Holotypus, collected at Farnham,

June 29, 1898, POM! isotypi, GH, NY, PH, RM, UTC!—*A. flexuosus* var. *Diehlii* Jones, op. cit., Index to Plates, nom. nud. *Pisophaca Diehlii* (Jones) Rydb. in N. Amer. Fl. 24: 324. 1929.

Rydberg separated *P. Diehlii* from *P. flexuosa* and related species by supposed characters of white flowers combined with a sessile, straight, unmottled pod. The fresh flowers, however, are lilac or lilac-tinged, and the pod, although truly sessile, is often incurved and as often mottled as not. The variety is very closely related to the form of var. *Greenei* with narrow pod found commonly in northcentral New Mexico, and it can only be distinguished by rather minute measurements of the calyx and shorter, more strongly incurved petals. Some detached pods of the two varieties are almost precisely alike in size, shape, curvature, and mottling.

The var. *Diehlii* has been reported by C. L. Porter (1951, p. 34) from Trinidad, Colorado, a station remote from the main, otherwise very natural range of dispersal in the Colorado Basin. The basis of the report (*Crider & Atkins 59,* RM) represents the form of var. *flexuosus* described earlier as Minor Variant No. 4.

39. Astragalus pictiformis

Low and slender, with an initial taproot and deeply buried root-crown giving rise directly, in young plants, to the stems, but these persisting basally, in mature plants, as thin, cordlike, obliquely ascending and widely creeping subterranean caudex-branches beset at the nodes with adventitious roots, some of which ultimately develop into taproots, the stems above ground and the herbage densely strigulose-villosulous with subappressed and ascending, largely straight or largely sinuous hairs up to (0.3) 0.35–0.6 mm. long, greenish-cinereous or canescent, the leaflets bicolored, pallid (beneath the vesture) below, deeper green and medially glabrescent above; *stems* arising singly or few together from the root-crown or from random points on the caudex-branches, simple, glabrous, and subterranean for a space of (2) 3.5–40 cm. (unless exposed by erosion on steep slopes), the aerial part 1.5–5 cm. long, either simple or spurred at the first 1–2 nodes above ground, the first of the 1–2 peduncles borne close to the ground; *stipules* 1.5–5 (6.5) mm. long, somewhat dimorphic, those at the buried nodes connate around the stem into a pallid, glabrous, papery-membranous, truncate or shortly bidentate sheath, the upper ones broadly ovate-acuminate or broadly lanceolate, subherbaceous, pubescent dorsally, connate through ± ⅓–½ their length; *leaves* (1) 1.5–5.5 cm. long, shortly petioled, with 9–17 mostly crowded, oblong-obovate to -oblanceolate or (especially in some lower leaves) suborbicular, obtuse or commonly retuse, flat or marginally involute leaflets 2–8 (10) mm. long; *peduncles* weakly ascending, declined in fruit, (1) 1.5–5 (6.5) cm. long; *racemes* shortly and rather closely 4–14-flowered, the loosely ascending flowers becoming horizontal or declined in age, the axis scarcely elongating, 0.5–2.5 cm. long in fruit; *bracts* thinly herbaceous, often purplish, triangular-ovate or broadly lanceolate, 1.3–2.7 mm. long; *pedicels* at anthesis slender, ascending, 0.8–1.4 mm. long, in fruit recurved, 1.4–2.5 mm. long; *bracteoles* commonly 2, minute, concealed by the vesture; *calyx* 4–6.3 mm. long, pubescent like the herbage with white hairs, the slightly oblique disc 0.7–1.2 mm. deep, the tube 3–4 mm. long, 2.4–2.9 mm. in diameter, the subulate teeth 1–2.5 mm. long; *petals* flesh-pink tinged with lilac, the banner purple-striate, the keel tipped with dull purple; *banner* recurved through ± 50°, ovate-cuneate, openly notched, (8.5) 9–11 mm. long, (5.9) 6.2–8 mm. wide; *wings* 8.7–10.8 mm. long, the claws 3.4–4.3 mm., the oblong-oblanceolate or -obovate, obtuse or truncate, nearly straight blades 5.7–7.3 mm. long, 2.3–2.6 mm. wide; *keel* 7–8.9 mm. long, the claws 3.1–4.3 mm., the half-obovate blades 4–5.2 mm. long, 2.3–2.8 mm. wide, abruptly incurved through ±95° to the bluntly or rather sharply deltoid apex; *anthers* 0.55–0.7 (0.8) mm. long; *pod* deflexed, subsessile, oblong or plumply oblong-elliptic in outline, 9–17 mm. long, 4–6 mm. in diameter, straight or commonly a trifle decurved, abruptly contracted at base into an obscure, stipelike neck no longer than wide and at apex into a

short, deltoid-acuminate, slightly declined beak, elsewhere obscurely and obtusely triquetrous, keeled ventrally by the prominent, thick, convexly arched suture, shallowly and openly grooved dorsally, the lateral angles obtuse, the thinly fleshy, green or purplish, ultimately stiffly papery and brownish valves strigulose, finely cross-reticulate; *ovules* (10) 14–18; *seeds* (little known) brown, smooth and sublustrous, ± 2.2 mm. long.—Collections: 11 (v); representative: *Waterfall 10,561* (OKLA, RSA); *Barneby 12,859, 12,869* (RSA); *Hershey 2112* (RM); *D. C. Ingram 2721* (P, UC, US).

Plains and foothills, in sandy or loose gravelly soils, on granite, sandstone, and limestone, sometimes on dunes or in sandy hollows, with juniper, scrub-oak, or in arid grassland, 4800-7000 feet, apparently not uncommon along the west slope of the upper Pecos Valley, from near Santa Rosa, Guadalupe County, New Mexico, south to the Davis and Hueco Mountains in Jeff Davis and Hudspeth Counties, Texas.—Map No. 15.—April to June, sparingly again in late summer and fall.

ASTRAGALUS PICTIFORMIS (resembling in growth-habit *A. ceramicus,* formerly *Phaca picta*) Barneby in Leafl. West. Bot. 8: 20. 1956.—"NEW MEXICO: . . . 3–4 miles west of Negra, Torrance County, 7 May (fl.) and 22 May (fl. & fr.), 1955, *Barneby 12,605 & 12,812* . . ."—Cotypi, taken from the same group of plants, CAS! isotypi, GH, NY, OKLA, POM, RSA, UTC.

In technical characters of the flowers and pods the Guadalupe milk-vetch, *A. pictiformis,* resembles *A. flexuosus* var. *Greenei.* It is distinguished principally by the low stature of the stems above ground and usually by the extensive ramification of the subterranean caudex-branches. The specimens of the type-series, which came from deep sandy soil, mimic the creeping stoloniferous habit of *A. ceramicus;* subsequent observation, however, of the species in two stations in Lincoln County, New Mexico, has shown that this may be modified into a less specialized form when the plants grow in stiffer, stonier soil. On a barren, gravelly clay bank in the foothills of the White Mountains near Angus, a colony of *A. pictiformis* formed a broken ground cover of dwarf, leafy stems; but here the root-crown was buried in the soil only shallowly, and along draws where erosion was active the caudex was sometimes exposed by weathering.

It seems probable that *A. pictiformis* is commoner than appears from herbarium collections now extant. The plants flower in spring in a region where the vernal flora is poor in number of species and offers scanty rewards to the collector. I passed hurriedly, on several occasions, across the Pecos Valley in late winter, spring, summer, and fall, and on each trip established a new station for the species. It cannot be really rare and doubtless has often been overlooked.

40. ASTRAGALUS PROXIMUS

Slender, sparsely leafy, thinly strigulose with straight, appressed hairs up to 0.35–0.6 mm. long, the herbage pale gray-green, subglaucescent when fresh, the leaflets glabrous above; *stems* erect or ascending, 1.5–4.5 dm. long, subterranean for a space of 1–8 cm., at emergence purplish and often branched at the first few nodes, thereafter simple, becoming stiff or wiry in age; *stipules* dimorphic, those at the subterranean and lower emersed nodes amplexicaul and connate into a papery-membranous, dorsally glabrous, subtruncate or bidentate sheath 1.5–4.5 mm. long, the median and upper ones either connate through half their length or decurrent and free, with lanceolate or subulate free blades; *leaves* 2–8 cm. long, all shortly petioled, with 7–11 distant, narrowly linear, linear-oblanceolate, or filiform, or (in some lower leaves) sometimes narrowly oblong, obtuse, often conduplicate leaflets 6–22 mm. long; *peduncles* strictly ascending, 3–11 cm. long; *racemes* very loosely (7) 12–40-flowered, the flowers spreading at early anthesis, declined thereafter, the axis 4–17 cm. long in fruit; *bracts* membranous, ovate or lance-ovate, 0.6–1.5 mm. long; *pedicels* at anthesis 0.5–1.2 mm. long, arched outward and 1.2–1.8 mm. long in fruit; *bracteoles* 0, rarely a minute scale; *calyx* 2.5–3.5 mm. long, strigulose with black, mixed black and white, rarely all white hairs, the disc

0.4–0.8 mm. deep, the campanulate tube 1.8–2.5 mm. long, 1.4–2 mm. in diameter, the teeth 0.6–1.1 mm. long, all subulate or either the ventral pair, or the lateral pair, or both, deltoid and shorter than the dorsal tooth; *petals* whitish, the banner and keel-tip lilac-tinged; *banner* recurved through 45–55°, ovate-cuneate, 6.1–7 mm. long, 3.5–4.8 mm. wide; *wings* 5.5–6.8 mm. long, the claws 1.8–2.8 mm., the lunately oblong-oblanceolate, obtuse blades 3.4–4.8 mm. long, 1.3–1.8 mm. wide; *keel* 4.2–5.3 mm. long, the claws 2–2.7 mm., the half-obovate blades (2.2) 2.5–2,9 mm. long, 1.4–1.9 mm. wide, abruptly incurved through 95–120° to the bluntly deltoid, often minutely porrect apex; *anthers* 0.3–0.4 mm. long; *pod* pendulous, stipitate, the stipe 1.2–2 mm. long, the linear-ellipsoid body 1–1.5 cm. long, 2.3–3.2 mm. in diameter, straight or a trifle arched downward, cuneate at both ends, apiculate at apex, obcompressed, rounded ventrally but obtusely carinate by the prominent ventral suture, flattened or openly and shallowly sulcate dorsally, the thin, greenish, glabrous valves becoming greenish-stramineous, finely reticulate; *ovules* 6–10; *seeds* not seen ripe, apparently ± 2 mm. long.—Collections: 15 (v); representative: *C. F. Baker 427* (GH, ND, NMC, WS); *Ripley & Barneby 5319* (CAS, NY, RSA), *8354* (CAS, RSA, UTC).

Mesas, bluffs, and low hills, in sandy, often alkaline clay soils derived from sandstone, among junipers or sometimes in sagebrush, 5400–7300 feet, local but locally plentiful in favorable seasons, valley of the upper San Juan River and its affluent creeks in northwestern New Mexico (San Juan, northwestern Sandoval, and western Rio Arriba Counties) and adjoining southwestern Colorado (southern La Plata and southwestern Archuleta Counties).—Map No. 16.—Late in April to July.

ASTRAGALUS PROXIMUS (Rydb.) Woot. & Standl. in Contrib. U. S. Nat. Herb. 19: 366. 1915, based on *Homalobus proximus* (very closely related to *H. flexuosus*) Rydb. in Bull. Torr. Club 32: 667. 1905.— "COLORADO: Arboles, June, 1889, C. F. Baker 421."—Holotypus, NY! isotypi, G, GH, K, MO, POM, US!—*Pisophaca proxima* (Rydb.) Rydb. in N. Amer. Fl. 24: 323. 1929.

The Aztec milk-vetch, *A. proximus,* is one of those plants which flatter the collector by being hard to see; yet, like many inconspicuous weeds when studied at close quarters, it reveals to careful scrutiny a delicate and precise beauty of structure. It might be likened to a very small-flowered version of *A. flexuosus,* but differs in its stiffer, more erect stems and in its few relatively long and narrow leaflets; to these features it owes its individuality of aspect. In the size of the flowers and in the few ovules it resembles *A. wingatanus* more closely, and these astragali, which are close neighbors but vicariant in range, are more closely allied than might be supposed from their positions in this account of sect. *Scytocarpi.* However, the sessile, laterally compressed, strigulose pod of *A. wingatanus* is technically quite different. The Aztec milk-vetch varies little except in superficial matters of stature and vigor, which depend on accidents of site and weather.

41. ASTRAGALUS FUCATUS

Perennial but sometimes flowering the first season, variable in stature, strigulose nearly throughout with straight, appressed or subappressed hairs up to 0.25–0.4 (0.6) mm. long, the stems commonly silvery-canescent, the herbage cinereous or greenish, the leaflets green and glabrous above; *stems* 1—several, diffuse and ascending, (0.4) 0.7–3 (exceptionally up to 7) dm. long, naked and subterranean for a space of (0) 1–4 cm., thereafter simple or (when robust) spurred or branched at 1–3 (5) nodes preceding the first peduncle, floriferous upward from below the middle, flexuous or zigzag distally; *stipules* (1) 1.5–4 (5.5) mm. long, the lowest amplexicaul and connate into a low, papery, collar-like (eventually fragile and easily ruptured) sheath, the rest fully or nearly amplexicaul but free or only obscurely connate, with broadly deltoid to lance-acuminate, subherbaceous or firmly papery, erect or recurved blades; *leaves* 3.5–10.5 (13) cm. long, all petioled

but the upper ones shortly so, with 9–17 distant, narrowly oblong-oblanceolate or linear-oblong, obtuse or emarginate, involute or conduplicate, rarely flat leaflets 4–20 (25) mm. long; *peduncles* 1–4 (6) cm. long, *racemes* loosely 9–22 flowered, the flowers at first ascending but horizontal or declined in age, the axis somewhat elongating, (1.5) 2–5 (8) cm. long in fruit; *bracts* submembranous, triangular-lanceolate, 0.8–2 mm. long; *pedicels* at anthesis slender, ascending, 0.7–1.4 mm. long, in fruit thickened, recurved, 1–2 (3.5) mm. long; *bracteoles* 0, rarely a minute scale; *calyx* 3.3–4.6 mm. long, silvery-strigulose with white hairs, the subsymmetric disc 0.7–1 mm. deep, the tube 2.4–3.3 mm. long, 2.1–2.6 mm. in diameter, the broadly subulate or triangular teeth 0.8–1.5 mm. long; *petals* reddish- or magenta-purple, the pale-eyed banner striate; *banner* abruptly recurved through ± 90°, broadly ovate-cuneate to rhombic-flabellate, 6.4–8.2 mm. long, 5.1–7.2 mm. wide; *wings* (1.1 mm. shorter to 0.4 mm. longer than the banner) 6.8–7.5 mm. long, the claws 2.1–2.6 mm., the elliptic-oblanceolate, obtuse, gently incurved blades 4.8–5.9 mm. long, 1.8–2.5 mm. wide; *keel* 6–7.2 mm. long, the claws 2.1–2.8 mm., the lunately half-elliptic blades 4.2–5 mm. long, 1.7–2.3 mm. wide, incurved through 80–90° and distally contracted into a triangular, subacute, slightly porrect, beaklike apex; *anthers* 0.4–0.55 mm. long; *pod* horizontally spreading or declined, sessile, broadly and plumply ovoid, obovoid, ovoid-ellipsoid, or subglobose, greatly inflated, 1.7–2.8 (3.2) cm. long, 1.2–2.2 cm. in diameter, contracted at base into a broadly obconic neck 0.6–2 mm. long and at apex into a deltoid, laterally compressed beak 0.8–2.5 mm. long, otherwise a trifle obcompressed, shallowly sulcate ventrally, the thin, brightly mottled valves becoming papery, delicately cross-reticulate and somewhat lustrous, loosely strigulose with short, subappressed or incurved-ascending hairs; *ovules* 21–32; *seeds* brown or olivaceous, often minutely purple-speckled, dull, smooth, (1.5) 2–3.3 mm. long.—Collections: 24 (ii); representative: *Peebles & Smith 13,371* (ARIZ, CAS, NY); *J. T. Howell 24,710* (CAS); *Barneby 13,097* (CAS, GH, NY, RSA, US); *Holmgren & Hansen 3444* (NY).

Sandy plains, desert washes, sometimes on dunes or in dunelike hollows under cliffs, associated with red sandstones, 4500–6200 feet, locally plentiful along the lower San Juan River in San Juan County, Utah, extending north to the Colorado River in extreme eastern Garfield County, and east just into northwestern New Mexico and adjoining Colorado, and along creeks flowing south and west into the Little Colorado River in eastern Coconino, Navajo, and Apache Counties, Arizona.—Map No. 15.—May to July, the fruit sometimes persisting into September.

ASTRAGALUS FUCATUS (painted, of the mottled pod) Barneby in Leafl. West. Bot. 9: 89. 1960.—"ARIZONA: near Hotevila, Navajo County, 6200 ft., June 8, 1937, *Peebles 11,392*."—Holotypus, *Peebles 13,392* (!), CAS, isotypi, NY (labeled "5 miles w. of Oraibi"), US!—*A. subcinereus* sensu Jones, Rev. Astrag. 106, pro parte, exclus. syn. 1923. *Phaca subcinerea* sensu Rydb. in N. Amer. Fl. 24: 351. 1929; non *A. subcinereus* Gray.

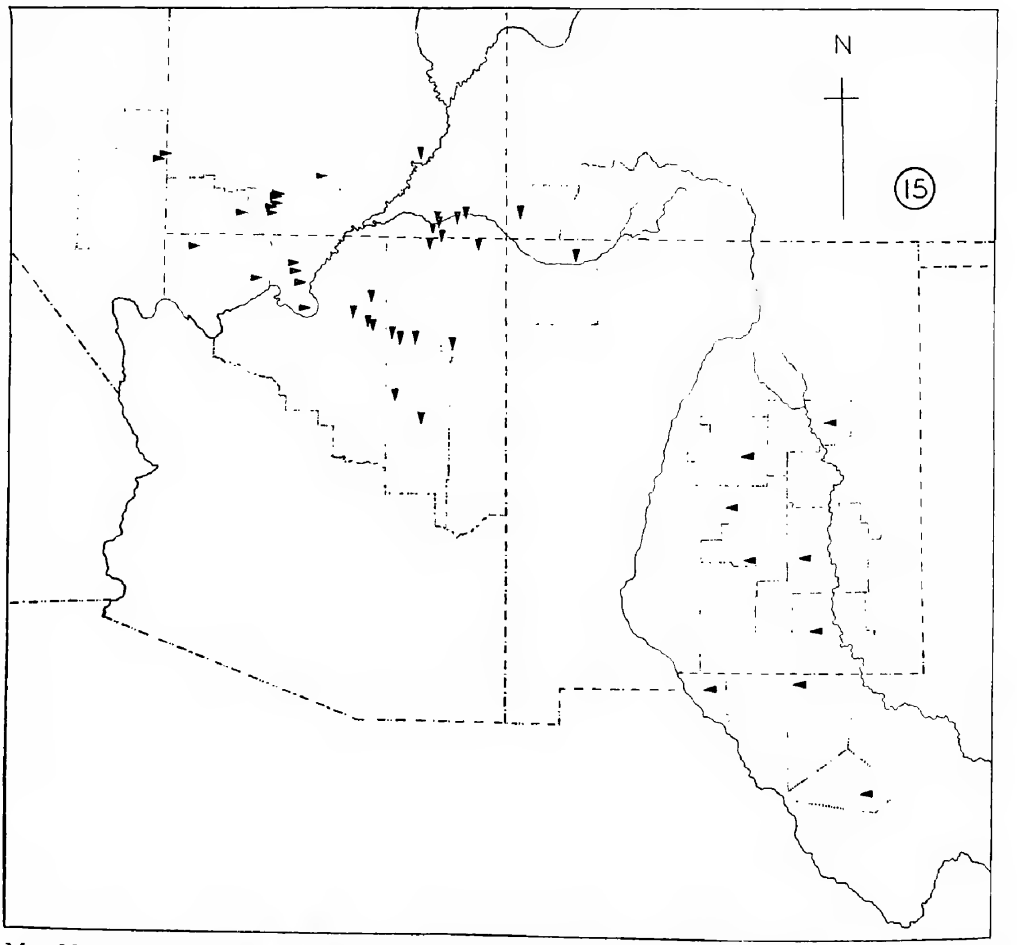
When christened *A. fucatus* the Hopi milk-vetch was new in name only, being substantially the *A. subcinereus* of Jones's Revision and of the floras covering its range of dispersal. It is precisely, as shown by his annotations (NY), the *Phaca subcinerea* of Rydberg (1929). Re-evaluation of the typus of *A. subcinereus* Gray showed that it represents a form of *A. Sileranus* Jones, and consequent shift of epithets left the present species without a name. The point is raised again under *A. subcinereus* (q.v.).

Despite the fact that Jones placed *A. fucatus* and *A. subcinereus* in different sections of *Astragalus*, the two species are closely related and share the subterranean root-crown, connate lower stipules, and persistent pod of sect. *Scytocarpi*. It is only in the pod's inflation that either resembles the *Inflati* or so-called phacas. The differently shaped keel-petals, generally larger or at least relatively broader pod, straight appressed vesture, and more numerous ovules are the features useful in distinguishing *A. fucatus* from its close kin. In addition, the plants are commonly of more open and wiry growth-habit than *A. subcinereus*, the leaflets are comparatively

narrower and more distantly spaced along the rachis, and the whole appearance suggests a more harshly xerophytic habitat. The flowers of *A. fucatus* are reddish-purple when fresh (although the color fades rapidly in dried specimens); those of *A. subcinereus* are whitish or ochroleucous, faintly lilac-tinged or veined with dull brownish-purple.

42. Astragalus subcinereus

Diffuse or prostrate, slender or quite coarse and leafy, villosulous or hirsutulous with incurved-ascending, sinuously incurved, or horizontal to slightly retrorse, straight hairs up to 0.25–0.6 mm. long, the stems and herbage greenish, cinereous, or rarely canescent, the leaflets bicolored, brighter green above, either equally pubescent on both sides or medially glabrescent to subglabrous above; *stems* prostrate, decumbent, or weakly assurgent, (0.8) 1.5–7 dm. long, slender, naked, and subterranean for a space of (1) 2–10 (15) cm., above ground becoming stouter and commonly branched at the first or at each of 1–6 nodes preceding the first peduncle, floriferous upward from below or near the middle, flexuous or zigzag distally; *stipules* dimorphic, the lower ones papery, pallid, connate into a campanulate, loosely or closely amplexicaul, shortly bidentate sheath 1.5–4.5 mm. long, the rest firmer, herbaceous or sometimes foliaceous, broadly lanceolate or deltoid from a wide, amplexicaul base, obscurely or not connate, 2–6.5 mm. long, the blades commonly reflexed; *leaves* ascending, divaricate, or



Map No. 15. Arizona, New Mexico and parts of adjoining states. Range of ◖ *A. pictiformis*; of ◗ *A. subcinereus*; and of ◀▶ *A. fucatus*.

reflexed, 1.5–8.5 cm. long, shortly petioled or the uppermost subsessile, with (9) 13–21 (23) narrowly oblong-oblanceolate, oblong, oblong-obovate, or broadly obovate-obcordate, obtuse, emarginate, or retuse, flat or folded leaflets 2–16 mm. long; *peduncles* incurved-ascending or straight and divaricate, 1.5–8 (10) cm. long; *racemes* (5) 10–37-flowered, at early anthesis rather dense, the flowers spreading or declined, the axis ± elongating, (0.7) 1–7 cm. long in fruit; *bracts* papery-membranous, triangular, lanceolate, or linear-setaceous, 1–3 mm. long; *pedicels* at anthesis ascending, 0.5–1.1 mm. long, in fruit either strongly arched outward, divaricate, or variously contorted, a little thickened, 1–2.5 mm. long; *bracteoles* 0, rarely a minute scale; *calyx* (3.4) 3.8–6.3 mm. long, hirsutulous, villosulous, or loosely strigulose with white or mixed black and white hairs, the slightly oblique disc (0.5) 0.7–1.2 mm. deep, the campanulate tube (2.3) 2.5–3.6 mm. long, 1.9–3.2 mm. in diameter, the triangular-subulate or subulate-setaceous teeth (0.9) 1.1–2.9 mm. long; *petals* whitish or dull yellowish, commonly veined or suffused with pale lilac or brownish-purple, the keel sometimes faintly maculate; *banner* gently recurved through 45° (or further in withering), obovate-cuneate, rhombic-obovate, or subflabellate, (6.2) 6.6–9 mm. long, (4.2) 4.5–6.2 mm. wide; *wings* (0.7 mm. longer to 0.9 mm. shorter) 6.1–8.7 mm. long, the claws 2.6–3.6 mm., the linear-oblong, oblong, or narrowly oblanceolate, obtuse, truncate, or erose-emarginate, nearly straight blades (4) 4.2–5.9 mm. long, (1.4) 1.6–2.2 mm. wide; *keel* (5.7) 6–7.7 mm. long, the claws (2.5) 2.7–3.6 (3.8) mm., the half-obovate blades (3.5) 3.7–4.5 (4.9) mm. long, 1.8–2.4 mm. wide, abruptly incurved through (80) 85–95° to the sharply deltoid or broadly triangular, slightly porrect apex; *anthers* (0.4) 0.45–0.6 mm. long; *pod* widely spreading or declined, subsessile, broadly ovoid-ellipsoid, narrowly or plumply and obliquely ellipsoid, or subglobose, strongly inflated, (1) 1.2–2.7 cm. long, (6) 7.5–13 mm. in diameter, rounded or truncate at base and then contracted or cuneately tapering into an obscure, stipelike neck 0.3–1 mm. long, contracted distally into a short, triangular, erect or rarely declined, laterally flattened beak, otherwise subterete to quite strongly obcompressed, openly sulcate ventrally and sometimes also (but shallowly) dorsally, the thinly fleshy, green or purple-tinged, brightly red-mottled valves becoming firmly papery or papery-membranous, brownish, cross-reticulate, densely to quite thinly villosulous or loosely strigulose with spreading or incurved hairs; *ovules* (10) 12–20; *seeds* brown, sometimes purple-speckled, smooth, dull, 1.9–3.1 mm. long.—Collections: 16 (ii); representative material cited below.

Open flats in yellow pine forest, brushy or wooded hillsides among oaks and in juniper-piñon forest, mostly 6000–8800 (9000) feet, descending (in Nevada) to sandy valley floors at 5500 feet, locally plentiful in scattered stations: Kaibab and Kanab Plateaus, northern Coconino and Mohave Counties, Arizona; Virgin-Sevier watershed in western Kane County, Utah; Needle Mountains and upper Muddy River Valley in eastern Lincoln County, Nevada.—Map No. 15.—May to September.

ASTRAGALUS SUBCINEREUS (grayish) Gray in Proc. Amer. Acad. 13: 366. 1878.—"Mokiak Pass in the northwestern part of Arizona, near the Utah boundary, Dr. E. Palmer, 1877."—Holotypus, *Palmer 117* of the 1877 collection, GH! isotypi (some labeled "s.w. Utah"), K, MO, NY, PH, US!—*Phaca subcinerea* (Gray) Rydb. in Bull. Torr. Club 40: 47. 1913.

Astragalus Sileranus (Andrew Lafayette Siler, 1824–1898, Mormon rancher, collected extensively in s. Utah) Jones in Zoë 2: 242. 1891.—"Collected by me on June 23, 1890, in Sink Valley, southern Utah, at about 7000 feet altitude."—Holotypus, POM! isotypi, CAS, GH, MO, NY, US!—*Phaca Silerana* (Jones) Rydb. in Bull. Torr. Club 40: 47. 1913.

Astragalus Sileranus var. *cariacus* (from *Cariacus*, a genus of deer, in allusion to the type-locality) Jones in Proc. Calif. Acad. Sci. II. 5: 642. 1895.—"No. 6036. September 12, 1894,

Elk Ranch, Utah, 7000° alt.," the data expanded later (Jones, 1923, p. 197) to "Elk head Ranch on the upper Virgin River," apparently in w. Kane County.—Holotypus, POM (3 sheets)!

The Siler milk-vetch, *A. subcinereus,* varies considerably in stature, in amplitude of the herbage, and in orientation of the hairs throughout the plant-body. The species is known from Arizona through well-documented specimens only from the Kaibab and Kanab Plateaus, where it ranges from the piñon-belt at 6000 feet upward into open parklands in yellow pine forest at about 9000 feet. The typus is said to have originated at Mokiak Pass, but Palmer's labels are so often imprecise that it may have been collected at some distance from the pass itself. The species has not been seen there in recent years, in spite of particular search (cf. *A. artipes,* supposedly collected with it). At the lower elevations in Arizona, the plants are loosely strigulose with sinuously incurved hairs and the stems are relatively short and weakly ascending. Plants from the pine belt are prostrate, with stems often longer, up to 6.5 dm., but sometimes no more than 1.5 dm. long; and at the same time the vesture varies from sinuously incurved to spreading or retrorse and straight. The peduncles may be either incurved or straight and divaricate, but in Arizona the leaflets are consistently narrow, about 2–13 mm. long and 1–3 mm. broad. The pod in this area is usually small, 1–2, rarely 2.3 cm. long, and papery or papery-membranous in texture (*Eastwood & Howell 1064,* CAS, NY; *Jones 6052,* POM, NY; *Kearney & Peebles 13,682,* CAS).

On the Sevier-Virgin divide in Utah the prevailing phase of *A. subcinereus* (= *A. Sileranus* sens. strict., including var. *cariacus*) is a coarser, more leafy plant than the Arizona type, with weakly diffuse or prostrate stems 3–7 dm. long, sometimes hanging down in festoons from steep clay banks in the oak brush. Its range extends down to 5700 feet and up into pine forest at about 7000 feet, where the plants become truly prostrate and loosely matted. Here the leaflets are normally of a broad type and deeply notched, about 6–16 mm. long and up to 4–10 mm. broad, and the vesture is consistently composed of horizontal or retrorsely directed hairs. The upper stipules are broader in Utah than in Arizona, commonly foliaceous and broader than the stem, and the peduncles are characteristically divaricate. The rather firmer-walled pod varies from 1.5 to 2.8 cm. in length, a comparatively narrow, fusiform fruit over 2 cm. long and 5–8 mm. in diameter being the only diagnostic feature of the inconsiderable var. *cariacus.* The populations in Utah can be distinguished collectively from those of Arizona only by the broader leaflets, and it seems best to follow Jones in considering the plants in these two areas as conspecific in the narrowest sense, although tending to diverge in several minor characters (*Jones 25,429,* CAS, POM; *Ripley & Barneby 4798,* CAS, RSA; *Holmgren & Tillett 9659,* RSA).

In southeastern Nevada *A. subcinereus* is represented by a third, slightly different type of plant found in low, sandy valleys among sagebrush at about 5500 feet. Here the stems and foliage are densely and canescently villosulous with sinuous or curly subappressed hairs mixed with longer, incurved-ascending ones. The relatively stiff assurgent stems are 2–3.5 dm. long. The leaflets vary from broad to narrow (2–5 mm. wide). The firmly papery pod is 1.3–2.5 cm. long. This appears to be a xerophytic ecotype but has no character peculiar to it other than the comparatively dense pubescence (*Train 2632,* NY; *Ripley & Barneby 6337,* CAS, GH, NY, RSA).

It should be emphasized that the range of variation in the flower-parts, ovule- and leaflet-number, and in other organs, is nearly identical throughout the range of *A. subcinereus,* which must be regarded as a somewhat polymorphic species composed of many minor variants.

As already mentioned under the preceding species, the epithet *subcinereus* has been universally applied in recent literature to *A. fucatus.* There is no question, however, that *Palmer 117,* typus of *A. subcinereus,* represents the Arizona phase of *A. Sileranus.* The present disposition of the name is consistent with all that is known of the dispersal and ecology of the two species concerned; *A. fucatus* is native to the high sandstone deserts to the east and south of the Colorado River, far distant from the type-locality of *A. subcinereus* which, whether Palmer's label is interpreted as literally or only approximately correct, must lie well within the known area of *A. Sileranus.* Misunderstanding of the typus of *A. subcinereus* arose partly from the circumstance that the remaining flowers are abnormal, as may be seen by comparing their calyces with those persistent at the base of successfully ripening fruits. The former are greatly enlarged and, like the petals, distorted and fleshy-thickened. Flowers of this sort, which have been observed in many species of *Astragalus,* are host to the mycelium of a rust and ultimately the ovary ripens into a more or less amorphous capsular structure filled with powdery black spores. Gray's description of the flowers as "greenish with a purple tip" was probably taken from diseased flowers, and Rydberg's key character of "deltoid calyx-teeth," employed in *North American Flora* to distinguish *A. subcinereus,* can be traced at least in the first instance to the same source.

X (ii). Subsectio Wingatani

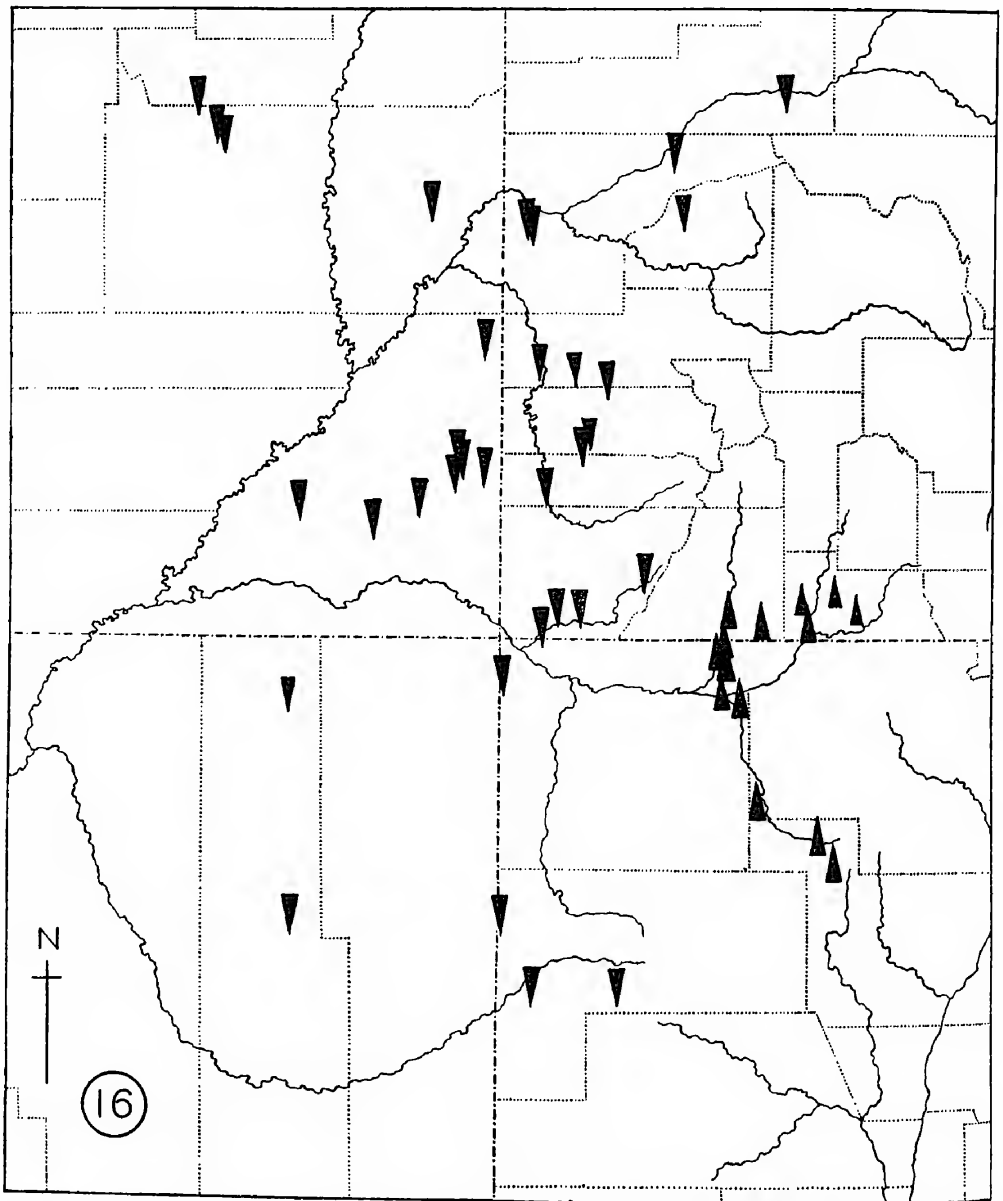
Like subsect. *Scytocarpi,* but the leaflets, especially of some upper leaves, sometimes reduced in size, number, or both; *flowers* very small, the keel ± 3.5–5.5 mm. long; *calyx-tube* campanulate; *pod* deflexed, subsessile or shortly stipitate, symmetrically or obliquely ellipsoid, strongly compressed laterally, bicarinate by the salient sutures; *ovules* 4–8.—Sp. 1, of the Colorado Basin.

Astragalus sect. Scytocarpi subsect. Wingatani, subsect. nov., omnibus fere cum *Scytocarpis* genuinis congruentes nisi legumine de latere compresso, suturis bicarinato.—Sp. unica: *A. wingatanus* Wats.

43. Astragalus wingatanus

Usually slender and wiry, often only sparsely leafy, thinly strigulose with straight, appressed, or subappressed hairs up to 0.2–0.5 mm. long, the herbage green or pallid green, the growing tips sometimes canescent, the leaflets glabrous above; *stems* several or numerous, diffuse or incurved-ascending, 1.5–4 (6.5) dm. long, simple and subterranean for a space of (0) 1.5–15 cm., commonly branched divaricately or spurred at the first emersed nodes, flexuous or zigzag distally; *stipules* scarious or early becoming so, 1.5–5 (8) mm. long, somewhat dimorphic, those at the buried and lower exposed nodes connate through at least half and sometimes their whole length into a truncate or shortly bidentate sheath, the upper ones becoming narrower and successively less connate, the uppermost with lanceolate, subherbaceous blades united at base only or nearly free; *leaves* (1.5) 2.5–6.5 cm. long, shortly petioled or the uppermost subsessile, with 3–15 (17) linear, linear-oblanceolate, narrowly elliptic, or filiform, or (especially in some lower, rarely in all leaves) oblong-elliptic, either subacute, obtuse, or (when broad) shallowly retuse, flat or involute leaflets (2.5) 4–18 mm. long, the terminal one commonly longer than the last pair, the lateral ones sometimes reduced or even lacking in some upper leaves; *peduncles* strictly erect or incurved-ascending, rather stiff, (2) 3–9 cm. long; *racemes* loosely or remotely (5) 10–35-flowered, the flowers ascending at early anthesis, declined thereafter, the axis elongating, (3.5) 5–16 cm. long in fruit; *bracts* papery, ovate or lanceolate, 0.5–2 mm. long; *pedicels* at anthesis straight, ascending, 0.8–1.5 mm. long, in fruit either strongly arched out- and downward, or straight and abruptly divaricate, or deflexed, 1.5–3 mm. long; *bracteoles* 0–2, minute when present; *calyx* (2) 2.5–3.7 mm. long, strigulose with variably proportioned white and black, all white, or all black hairs, the subsymmetric disc 0.5–0.8 mm. deep, the campanulate tube (1.5) 1.6–2.6 mm. long, 1.2–1.8 (2) mm. in diameter, the subulate teeth 0.5–1.4 mm. long, the ventral pair often broadest and shortest, the orifice often oblique; *petals* either bicolored, lilac-purple with contrasting white wing-tips, or whitish with banner and keel-tip lilac-suffused or -veined; *banner* recurved through ± 50°, broadly rhombic-obovate or suborbicular beyond the short-cuneate claw, shallowly or deeply notched, 5.6–8 mm. long, 4–6 mm. wide; *wings* 4.3–7.1 mm. long, the claws 1.2–2.4 mm., the obovate, obliquely elliptic, or broadly oblanceolate, obtuse or obscurely erose-emarginate blades (3.1) 4–5.6 mm. long, 1.3–2.2 mm. wide, both incurved but the left one more abruptly so and its inner margin infolded; *keel* 3.5–5.4 mm. long, the claws (1.3) 1.7–2.5 mm., the half-obovate or nearly half-circular blades 2.3–3.2 mm. long, 1.3–2 mm. wide, incurved through 90–110° to the obtusely deltoid, sometimes obscurely porrect apex; *anthers* 0.3–0.45 (0.5) mm. long; *pod* deflexed or pendulous, subsessile or shortly stipitate, the stipe up to 1.7 mm. long but usually less than 1 mm. long or subobsolete, the body symmetrically or obliquely ellipsoid, oblong-ellipsoid, or somewhat clavately ellipsoid, straight or rarely a little incurved, (6) 9–15 mm. long, (2.5) 3–4.5 mm. in dia-

meter, cuneate or cuneately tapering at base, abruptly acute and mucronulate at apex, strongly compressed and 2-sided when first formed but the valves somewhat distended by the ripening seeds and becoming low-convex, bicarinate by the prominent but slender sutures, these either equally convex-arcuate as seen in profile, or the dorsal one straight and the ventral one convex, the thinly fleshy, greenish, purple-speckled or -mottled, glabrous valves becoming papery, stramineous, delicately reticulate; *ovules* (4) 5–8; *seeds* dark brown, lustrous but more or less pitted and wrinkled, 2.8–3.6 mm. long.—Collections: 37 (viii); representative: *W. A. Weber 4720* (CAS, SMU, TEX, WS); *Ripley & Barneby 5353* (CAS, NY, RSA); *Holmgren & Hansen 3336* (NY, WS, WTU); *Barneby 12,774* (CAS, RSA).



Map No. 16. Southeastern Utah and parts of adjacent states. Range of ▼ *A. wingatanus*; and of ▲ *A. proximus*.

Sandy clay hillsides, talus beneath sandstone cliffs, open flats in piñon-juniper woodland, and about oak thickets, 5000–7500 feet, widely distributed and locally plentiful in the Colorado Basin south of Tavaputs Escarpment, from Price River, Utah, east to the Grand River in Garfield County, Colorado, south to the Four Corners country and, becoming rarer, to the head of the Zuñi River in McKinley County, New Mexico, and the Navajo Reservation in northeastern Arizona—Map No. 16.—Mid-April to July, the fruit sometimes persisting into September.

ASTRAGALUS WINGATANUS (of Fort Wingate) Wats. in Proc. Amer. Acad. 18: 192. 1883 (*"Wingatanus"*).—"At Fort Wingate, New Mexico (Dr. W. Matthews, 1882)."—Holotypus, GH! isotypi, some dated 1883, K, P!—*Homalobus wingatanus* (Wats.) Rydb. in Bull. Torr. Club 31: 563. 1904 (*"wingatensis,"* corrected to *"wingatanus"* by A. Hell. in Muhlenbergia 1: 145. 1906).

Astragalus Dodgianus (Col. D. C. Dodge, apparently a friend of Jones) Jones in Zoë 3: 289. 1893.—"May 7, 1891, at Thompson's Springs, Eastern Utah . . ."—Holotypus, collected by M. E. Jones, POM! isotypi, GH, NY!—*Homalobus Dodgianus* (Jones) Rydb. in Bull. Torr. Club 40: 52. 1913 (*"Dodgeanus"*).—*A. wingatanus* var. *Dodgianus* (Jones) Jones, Rev. Astrag. 69, Pl. 1. 1923 (*"Dodgeanus"*).

Astragalus acerbus (bitter, from the "very bitter, tealike taste") Sheld. in Minn. Bot. Stud. 1: 123. 1894.—"Collected near Glenwood Springs, Colorado, June [18], 1893, by Mr. DeAlton Saunders of the University of Nebraska."—Holotypus, MINN! isotypus, NY!—*Homalobus acerbus* (Sheld.) Rydb. in Bull. Torr. Club 32: 666. 1905. *A. tenellus* fma. *acerbus* (Sheld.) Macbr. in Contrib. Gray Herb., New Ser., 65: 35. 1922.

The Fort Wingate milk-vetch is variable in minor aspects of the pod, and so much so in the development of the leaves as to account, in great part, for the synonymy which has developed around the species. The pod varies from subsessile to distinctly stipitate, and in profile from symmetrically oblong-elliptic to almost half-elliptic, the sutures being nearly parallel or equally convex in the first case, the dorsal one straight and the ventral convex in the second. These variations occur independently of one another—to some degree, within populations of limited extent—and must be considered normal for the whole species. In strictly typical *A. wingatanus* the leaves have about five to seven pairs of elliptic to oblong leaflets, those of the lowest leaves tending to be broader than in succeeding ones. In arid environment, especially at the foot of sandstone buttes at low elevations in the valleys of the Price and Grand Rivers, and more rarely southward, *A. wingatanus* is represented by a xerophytic ecotype in which the lateral leaflets are linear or linear-filiform and reduced to 1–5 pairs, tending to become rudimentary, scattered, or even wanting in some upper leaves. The most junceous forms appear quite distinct at first sight from the leafier ones, but field experience and a full herbarium record have provided evidence of a gradual transition between the extremes. The typus of *A. Dodgianus* provides an example of few leaflets combined with oblique pods, that of *A. acerbus* a combination of symmetric pods with scanty foliage. If so desired these two forms might be treated collectively as *A. wingatanus* var. *Dodgianus,* although it is here preferred to treat them as two of a series of minor variants of the Fort Wingate milk-vetch.

The epithet *Dodgianus* was so spelled in the original publication and repeated in the same form by Jones in his seventh *Contribution to Western Botany* (1898, p. 636); it seems not to have been a misprint, although emended to *Dodgeanus* by Rydberg (1913, l.c.) and adopted in the corrected version in Jones's Revision. The change of Watson's epithet *wingatanus* to *wingatensis* is certainly illegitimate, even though the latter is stylistically preferable.

The close affinities of *A. wingatanus* have been assumed to lie with *A. tenellus,* and it may come as a surprise to find the two species assigned here to different sections. It is true that the pods are similar in form; but in its buried root-crown, general habit of growth, and elongated fruiting racemes, *A. wingatanus* has more in common with the *Scytocarpi* than with the typical *Ervoidei.* The pod of *A. flexuosus* var. *Diehlii* when, as often, it is somewhat laterally compressed, approaches that of the oblique forms of *A. wingatanus,* so that the latter is in reality less anomalous among the *Scytocarpi* than might be supposed. The clear line of relationship from *A. tenellus* leads through *A. vexilliflexus* into *A. Kentrophyta,* in a direction remote from *A. flexuosus* and its allies.

Mention has been made already of the resemblances between *A. wingatanus* and *A. proximus* of the preceding subsection, resemblances so many and so close that Jones believed the two species to be forms of one. While perfectly distinct, they are no doubt closely related. Other instances of pairs of related species differing in the direction of the pod's compression are noted elsewhere in these pages.

The Fort Wingate milk-vetch was first collected in 1869, somewhere in New Mexico, by Edward Palmer (No. *67*, NY).

X (iii). Subsectio Microlobi

Like subsect. *Scytocarpi; flowers* very small, the obtuse keel 3.7–6.1 mm. long; *calyx-tube* campanulate or turbinate-campanulate; *pod* declined or deflexed, sessile, obliquely suborbicular or ovoid-ellipsoid, less than 1 cm. long, dorsally flattened or sulcate, the leathery valves transversely rugulose-reticulate; *ovules* 5–9.—Sp. 1, of the Great Plains and east foothills of the Rocky Mountains.

Astragalus sect. Scytocarpi subsect. Microlobi (Gray), stat. nov., based on *Astragalus* sect. *Microlobi* Gray in Proc. Amer. Acad. 6: 202. 1864.—Sp. typica: *A. microlobus* Gray = *A. gracilis* Nutt.—*Astragalus* sect. *Rugocarpus* Sheld. in Minn. Bot. Stud. 1: 156. 1894, sine descr., apparently a substitute for the preceding.

Microphacos Rydb. in Bull. Torr. Club 32: 663. 1905.—Generitypus: *M. gracilis* (Nutt.) Rydb. = *A. gracilis* Nutt.—*Astragalus* subgen. *Microphacos* (Rydb.) Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 199. 1941.

44. Astragalus gracilis

Slender, sparsely leafy, strigulose nearly throughout with fine, straight, appressed or a few narrowly ascending hairs up to 0.3–0.5 mm. long, the stems and herbage greenish or cinereous, the leaflets glabrous or nearly so and brighter green above; *stems* few or several, 1.5–4 dm. long, diffuse, ascending, or sometimes erect, simple and subterranean for a space of 1–7 cm., commonly branched at the first emersed nodes, the branches divaricate and ascending, passing upward into spurs or directly into peduncles, less often simple throughout; *stipules* (1) 1.5–4 mm. long, dimorphic, those at the buried and lower aerial nodes papery-membranous or early becoming so, amplexicaul and connate into a truncate or bidentate sheath or low collar, the median and upper ones firmer, often herbaceous, progressively less united upward, the uppermost free or united by a stipular line, with deltoid, triangular, or triangular-caudate, mostly erect blades; *leaves* 2.5–7 cm. long, all shortly petioled or the uppermost subsessile, with 9–17 linear, linear-oblong, narrowly oblong, oblanceolate, or cuneate-oblong, commonly retuse but when narrow truncate to obtuse, flat or involute leaflets (3) 5–20 (25) mm. long; *peduncles* erect, ascending and incurved, or divaricate, 3–9 cm. long; *racemes* loose or early becoming so, (6) 12–40 (55)-flowered, the flowers ascending and then horizontal or at length declined, the axis elongating, (1.5) 3–13 cm. long in fruit; *bracts* submembranous, ovate or subulate, 0.7–1.5 mm. long; *pedicels* at anthesis ascending, 0.7–1.1 mm. long, in fruit arched out- and downward or horizontally spreading, 1–1.8 mm. long; *bracteoles* 0–2, minute when present; *calyx* 2.1–3.3 mm. long, strigulose with white or rarely a few black hairs, the subsymmetric disc 0.4–0.7 mm. deep, the campanulate or turbinate-campanulate tube 1.5–2.7 mm. long, 1.6–2.4 mm. in diameter, the deltoid or triangular-subulate teeth 0.4–0.9 mm. long, the ventral pair broadest, sometimes broader than long; *petals* pale lilac or purplish, the banner often purple-veined; *banner* recurved through ± 45°, ovate-cuneate, 5.3–8.4 mm. long, 4–5.8 mm. wide; *wings* as long or a trifle shorter, the claws 1.5–2.7 mm., the obliquely elliptic or obovate, obtuse blades 4–5.7 mm. long, 1.6–2.5 mm. wide, both incurved but the left one more abruptly so and its inner margin infolded; *keel* 3.7–6.1 mm. long, the claws 1.6–2.9 mm., the half-obovate or nearly half-circular blades 2.4–3.8 mm. long, 1.6–2.2 mm. wide, abruptly incurved through 95–130° to the rounded apex; *anthers* 0.3–0.45 mm. long; *pod* declined or deflexed, or from decumbent branches horizontally spreading, sessile, obliquely suborbicular, plumply ovate, or ovate-elliptic in dorsal view, (4) 4.3–8 (9) mm. long, 2.2–3.6 mm. in diameter, obtuse at base, abruptly cuspidate at apex, obcompressed, the dorsal face either flattened or openly and shallowly

sulcate, the ventral face convex, carinate by the prominent, thickened suture, the somewhat fleshy, densely strigulose or minutely villosulous valves becoming brown or stramineous, stiffly leathery and rigid, transversely rugulose-reticulate; *dehiscence* tardy; *ovules* 5–9; *seeds* brown or greenish-brown, smooth or minutely pitted, 2.3–3.3 mm. long.—Collections: 104 (viii); representative: *C. L. Hitchcock 15,868* (NY, RSA, SMU, WS); *C. L. Porter 3698* (NY, SMU, TEX); *E. Nelson 3388* (NY); *Rydberg & Vreeland 5982* (NY); *Ripley & Barneby 10,568* (RSA).

Sandy bluffs, barren hilltops, dunes, and gullied washes on the prairies, sometimes on shale outcrops, on gypsum beds, or on dry gravelly hillsides among junipers, (1300, northward) 2800–6500 (7250) feet, widespread and locally common on the Great Plains and west into the foothill valleys and tablelands of the Rocky Mountain piedmont, from southwestern North Dakota to the upper Missouri and Yellowstone Valleys in southcentral Montana, south to western Oklahoma, to the headwaters of the Colorado River in western Texas, and to the upper Canadian River in northeastern New Mexico; apparently isolated on the Saskatchewan River between Prince Albert and Rosthern, Saskatchewan.—Map No. 17.—May to July.

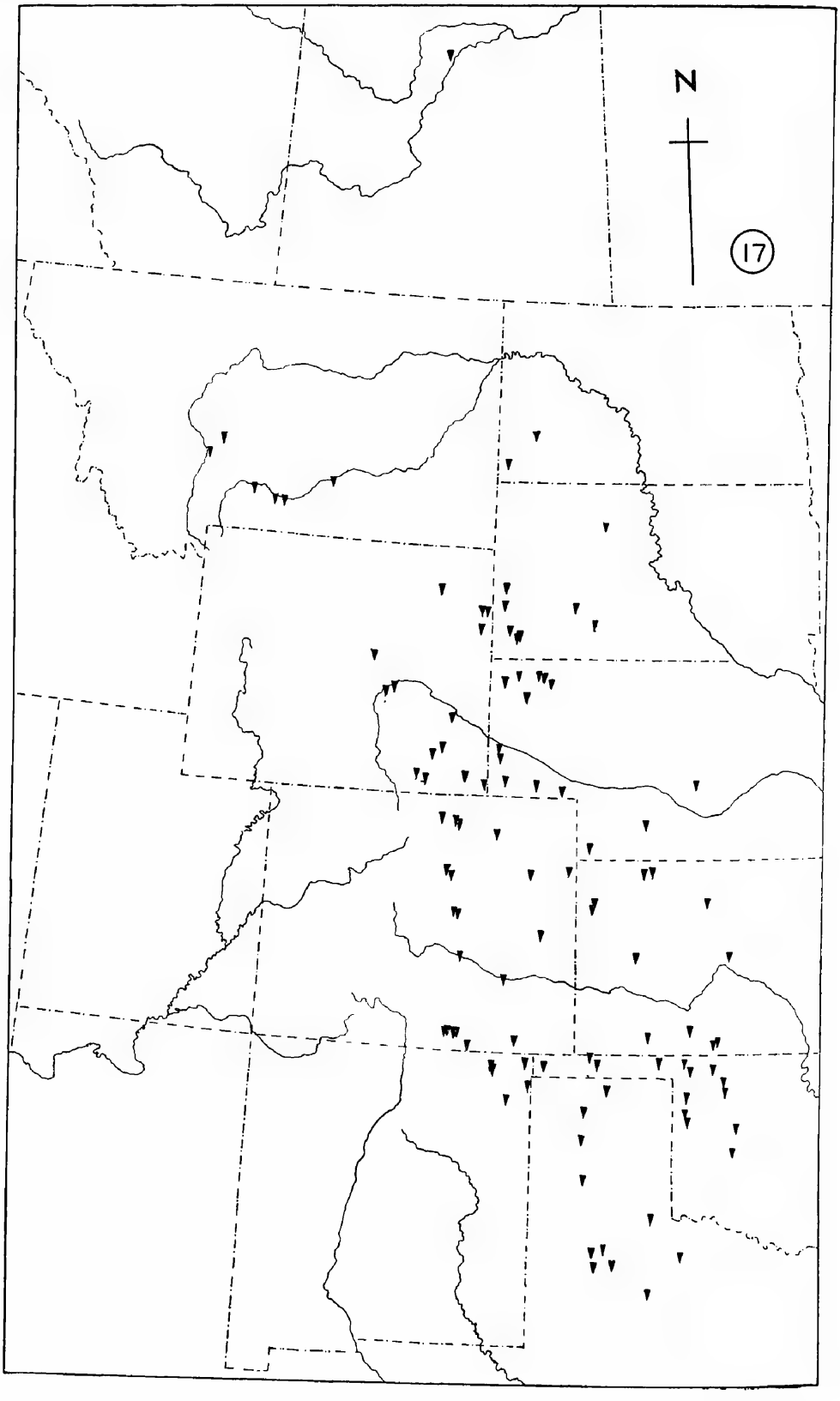
ASTRAGALUS GRACILIS (slender) Nutt., Gen. 2: 100. 1818.—"From White River to the Mountains, on the plains of the Missouri."—Nuttall cited his own *A. gracilis* of Fraser's Catalogue, a nomen nudum, and *Dalea parviflora* Pursh, of which he had seen a spm. in herb. Lambert. The name *A. gracilis* is therefore best treated as a legitimate substitute for *Dalea parviflora* (small-flowered) Pursh, Fl. Amer. Sept. 474. 1814.—"On the banks of the Missouri."—Holotypus, labeled in Pursh's hand "*Dalea parviflora.* Mr. Nuttall," PH! isotypus, labeled "*D. parviflora.* Herb. Lambert.," NY!—The Nuttall spms. from the Platte or the Rocky Mts. (BM, K, NY) probably date from 1834.—*Tragacantha parviflora* (Pursh) O. Kze., Rev. Gen. 941. 1891. *Astragalus parviflorus* (Pursh) MacMill., Metasp. Minn. Vall. 325. 1892; non Lamk., 1783. *Microphacos parviflorus* (Pursh) Rydb. in Bull. Torr. 40: 51. 1913. *Astragalus Microphacos* (the generic name) Cory in Rhodora 38: 405. 1936. *A. gracilis* var. *parviflorus* (Pursh) Gates in Trans. Kans. Acad. Sci. 42: 137. 1940.

Astragalus gracilis β *erectus* (erect) Hook. in Lond. Jour. Bot. 6: 210. 1847.—Upper Platte . . . [Geyer] n. 223."—Holotypus, labeled "Missouri & Oregon, 1845.," K! isotypi, BM, G!

Astragalus parvifolius Nutt. ex Gray in Proc. Amer. Acad. 6: 202. 1894, in syn., nomen. —This name was taken from Nuttall's specimen labeled "*Astragalus *parvifolius.* Missouri.," PH! (Non *Phaca parvifolia* Nutt.).

Astragalus microlobus (with small pods) Gray in Proc. Amer. Acad. 6: 203. 1864.—"Plains of Nebraska, &c., to the Rocky Mountains."—Under this proposition Gray listed Nuttall specimens of *A. gracilis* at PH and in herb. Torrey.; *Parry 189;* and *Hall & Harbour 119.* The last mentioned, which provided the critical fruiting character, is chosen as lectotypus, GH! isotypus (fragm.), NY!—*Tragacantha microloba* (Gray) O. Kze., Rev. Gen. 946. 1891. *Microphacos microlobus* (Gray) Rydb. in Bull. Torr. Club 32: 663. 1905. *A. parviflorus* var. *microlobus* (Gray) Jones, Rev. Astrag. 193. 1923.

The slender milk-vetch, *A. gracilis,* is quite variable in length and compression of the pod, though scarcely more so than related *Scytocarpi,* and for many years two specific or varietal taxa, under changing names and combinations, have been recognized within it. At the small extreme the fruit is about 5 mm. long, shallowly excavated dorsally and thus inversely boat-shaped, and the transverse reticulations are so closely crowded together that the surface of the ripe valves becomes sharply rugulose. Of equally common occurrence is a pod up to 8 or even 9 mm. in length, flattened but not or only obscurely excavated dorsally, and here the nerves, although as many and equally prominent, are separated by wider intervals, and the valves are not more than strongly reticulate. The depth of the dorsal sulcus and the prominence of the cross-ribs seem to be functions of the pod's size rather than inherent qualities, and transition from one extreme condition to the other is gradual and complete. Those who have professed to see two entities within *A. gracilis* have emphasized several supporting characters. Gray associated the boat-shaped pod, under the epithet *gracilis,* with tiny flowers ($\pm$ 6 mm. long) disposed in dense, many-flowered racemes and linear leaflets 1.5–2 cm. long; and the dorsally flattened pod, under *A. microlobus,* with larger flowers ($\pm$ 8 mm. long) disposed in shorter and looser racemes and shorter leaflets of linear-oblong outline. Jones added to these differential characters the claim that *A. parviflorus* ($=$ *A. gracilis* sensu Gray) had only 5–9 leaflets as opposed to 9–17 in "var. *microlobus.*" Rydberg repeated these statements


N
17

in slightly modified form, but treated the plant with larger flowers and fruits as *Pisophaca gracilis*. Unfortunately the form of the fruit is not consistently correlated with any other character mentioned. Frequently a small, boat-shaped pod is combined with broad leaflets variable in length and number. Relatively large flowers may give rise to small, rugulose-reticulate pods. The racemes vary greatly in length, but independently of flower-size, although there is a strong tendency for the longer racemes to be smaller-flowered. It is a relevant fact that modern authors dealing with the complex have assigned approximately the same range to both species, a range over poorly differentiated prairie country where genetical separation of two admittedly close relatives is unlikely, unless there exists an effective mechanism to prevent cross-breeding. Yet if two species exist, they must hybridize freely to produce so many individuals of doubtful identity. Welsh (1960, p. 154) suggested that the form with short raceme and larger pod arose through introgressive hybridization between an original tall and many-flowered *A. gracilis* and the related *A. flexuosus*. But some of these forms are found so far outside the known range of *A. flexuosus* that the hypothesis is not convincing. It is probably correct to interpret the various states as individual variations of no taxonomic importance and to accept *A. gracilis* as genetically unstable and inherently variable. If this view is accepted, it will be academic to trace back through the literature the shifting estimates of Nuttall's several collections on which the epithets *gracilis, parviflorus,* and *parvifolius* ultimately rest.

X (iv). Subsectio Antonini

General characters of the section; *flowers* erect, larger than in subsect. *Scytocarpi,* the keel 10–13 mm. long; *calyx-tube* deeply campanulate to subcylindric; *pod* erect or narrowly ascending, sessile or nearly so, tumid or distinctly inflated but scarcely bladdery; *ovules* 20–30.—Sp. 1, of northeastern Mexico.

Astragalus sect. Scytocarpi subsect. Antonini, subsect. nov., floribus majusculis erectis, calycis tubo subcylindrico, fructu sessili subinflato erecto nec declinato inter affines insignes.—Sp. unica: *A. coriaceus* Hemsl.

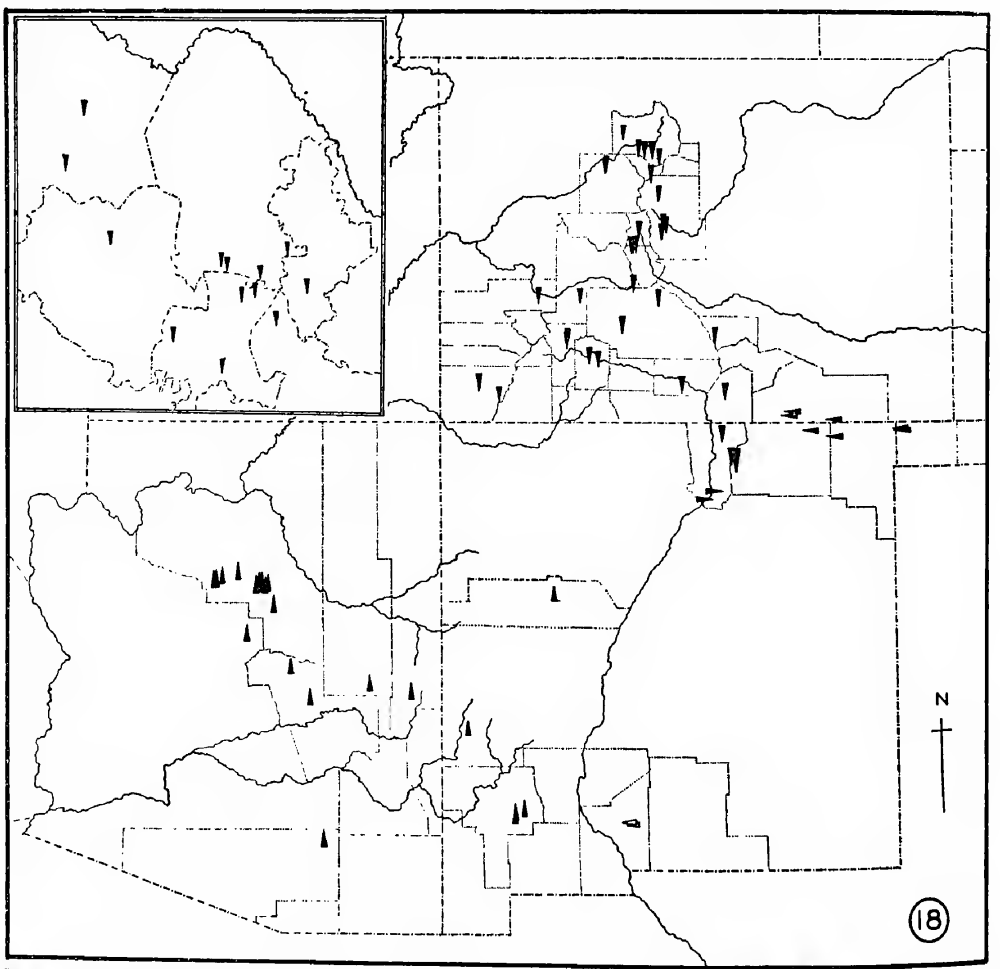
45. Astragalus coriaceus

Slender, diffuse or ascending, rather sparsely leafy, strigulose with appressed or subappressed hairs up to 0.25–0.45 mm. long, the herbage green or greenish-cinereous, the leaflets bicolored, brighter green and usually glabrous above or nearly so, rarely pubescent on both sides; *stems* several, 1.5–3.5 dm. long, naked and subterranean for a space of 1–15 cm., commonly branched on emergence, sometimes simple; *stipules* dimorphic, the lowest amplexicaul and connate into a subtruncate or bidentate sheath 1–2 mm. long, the median and upper ones lanceolate or triangular-acuminate, almost or fully amplexicaul, united by a mere line; *leaves* (2) 3.5–9 cm. long, subsessile, or the lowest shortly petioled, with 11–23 rather distant, oblanceolate or linear-oblanceolate, obtuse or retuse, flat or folded leaflets 2–20 mm. long; *peduncles* divaricate or incurved-ascending, (4) 5–14 cm. long, longer than the leaf; *racemes* loosely 5–12 (16)-flowered, the flowers erect-ascending, the axis becoming (1.5) 2–8 cm. long in fruit; *bracts* submembranous, triangular or nearly so, 1–2.5 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 1–1.5 mm. long, in fruit a little thickened, 1.4–3 mm. long; *bracteoles* 0-2, minute when present; *calyx* 5.8–8.6 mm. long, strigulose with black, white, or mixed black and white hairs, the oblique disc 1.1–1.9 mm. deep, the cylindric or cylindro-campanulate tube (4.5) 5–6.2 mm. long, 2.1–3 mm. (3.4) in diameter, the subulate or lance-subulate teeth (1) 1.5–3 mm. long; *petals* pink-purple or purplish; *banner* gently recurved through ± 45°, broadly rhombic-oblanceolate or rhombic, notched at apex, (13) 14–17 mm. long, 5.5–8.4 (10) mm. wide; *wings* (12) 13–15.2 mm. long, the claws 4.3–7 mm., the elliptic-oblanceolate, obtuse, erose-emarginate, or shallowly retuse, slightly incurved blades 8–9.6 mm. long, 2.5–3.3 mm. wide; *keel* 10–13 mm. long, the claws 4.1–6.5 mm., the half-obovate

Map No. 17. The Prairie States and Provinces of United States and Canada. Range of *A. gracilis.*

blades 5.8–7 mm. long, 2.5–3.3 mm. wide, incurved through 80–90° to the blunt apex; *anthers* 0.6–0.7 mm. long; *pod* erect, sessile or nearly so, sometimes contracted at base into a stipelike neck up to 1 mm. long, the body obliquely ovoid or ovoid-ellipsoid, turgid to decidedly inflated, either obtuse or turbinate at base, shortly deltoid or more rarely long-acuminate distally, (1.2) 1.4–2.2 (2.4) cm. long, (5) 6–9 mm. in diameter, slightly obcompressed, the thinly fleshy, green, minutely black- or white-strigulose valves becoming stiffly papery or almost leathery, castaneous, cross-reticulate; *dehiscence* apical; *ovules* 20–30; *seeds* (seldom seen) dark brown, sparsely or closely pitted, dull, 2.1–2.8 mm. long.—Collections: 12 (i); representative: *Purpus 4581* (POM, US); *Stanford, Weatherford & Northcraft 17* (ARIZ, GH, NY, PH), *468* (GH), *565* (ARIZ, GH, NY, PH); *Gentry 6962* (MICH, NY); *C. H. Mueller 2317* (MICH, TEX); *Waterfall 12,-516* (RSA); *Ripley & Barneby 13,464* (CAS, NY, RSA).

Dry open hillsides, on sandstone and limestone, ± 6500–10,000 feet, perhaps sometimes lower, in desert scrub, yucca- or mesquite-grassland, or in openings of oak or pine forest, apparently not uncommon, southeastern Chihuahua to northern and western Zacatecas, southern Coahuila, southern Nuevo León, and western San Luis Potosí.—Map No. 18.—June to November, the fruits long persisting.



Map No. 18. Colorado, Arizona, and New Mexico. Range of *A. Hallii*: ◀ var. *Hallii*, and ◀ var. *fallax*; of ◊ *A. Castetteri*; and of *A. puniceus*: ◖ var. *puniceus*, and ◗ var. *Gertrudis*. Inset, parts of northeastern Mexico. Range of *A. antoninus*.

ASTRAGALUS CORIACEUS (leathery, of the pod) Hemsl., Biol. Centr.-Amer., Bot. 1: 263. 1880, & Diag. Pl. Nov. Mex. 41. 1880.—"North Mexico, Zacatecas (Coulter). Hb. Kew."—Holotypus, K!—*Pisophaca coriacea* (Hemsl.) Rydb. in N. Amer. Fl. 24: 326. 1929.

Astragalus antoninus (of San Antonio de las Alanganes) Wats. in Proc. Amer. Acad. 17: 343. 1882.—"In the Sierra Madre, [40 miles] south of Saltillo (239); and also by Gregg . . ." —Holotypus *(Palmer 239),* collected in July, 1880, GH! isotypi, variously labeled "Canyon and elevated portion of Sierra Madre, 12–14 leagues s. of Saltillo, July 25–Aug. 1" or "Lerios Mountains, 15 miles, or 19 leagues, e. of Saltillo, July 10–13," K, NY, P, PH! paratypi, *Gregg 363,* GH, MO!—*Pisophaca antonina* (Wats.) Rydb. in N. Amer. Fl. 24: 327. 1929.

The leathery milk-vetch, *A. coriaceus,* stands apart from other *Scytocarpi* because of its ascending or erect flowers followed by fruits similarly erect on stiffly ascending pedicels. The habit of growth is similar to that of *A. flexuosus,* but *A. coriaceus* differs from all the genuine *Scytocarpi* in its large flowers. The flower-size suggests the next subsect. *Halliani,* but this differs in the broader calyx and ordinarily nodding or humistrate pod. The species appears to be less variable in its pubescence and other features than the majority of *Scytocarpi,* but it has been collected comparatively seldom and the full range of variation has probably not been sampled.

Jones already suspected that *A. coriaceus* and *A. antoninus* were conspecific. The typus of *A. coriaceus* (cf. phototypus, NY) is fragmentary and poorly preserved, but there is no doubt about its identity. During the preliminary studies I annotated most of the material in United States herbaria as *A. antoninus,* the genuine *A. coriaceus* being at the time unknown to me.

X (v) Subsectio HALLIANI

General characters of the section; *flowers* large, widely spreading or nodding at full anthesis, the keel 9–14 mm. long; *calyx-tube* deeply campanulate or broadly cylindro-campanulate, strongly oblique or dorsally gibbous at base; *pod* sessile or stipitate, loosely ascending (humistrate), declined, or deflexed, tumid or inflated, the valves stiffly papery or leathery; *ovules* 20–36.—Spp. 3, of middle elevations in the southern Rocky Mountains and adjacent foothills in Colorado, northern New Mexico, and extreme western Oklahoma, and of the Mogollon and outlying mountain systems in New Mexico and Arizona.

ASTRAGALUS sect. SCYTOCARPI subsect. HALLIANI (Rydb.), stat. nov., based on *Pisophaca* sect. *Hallianae* Rydb. in N. Amer. Fl. 24: 322. in clave. 1929.—Sp. typica: *P. Hallii* (Gray) Rydb. = *A. Hallii* Gray.

Pisophaca sect. *Famelicae* Rydb. in N. Amer. Fl. 24: 322, in clave. 1929.—Sp. typica: *P. famelica* (Sheld.) Rydb. = *A. Hallii* var. *fallax* (Wats.) Barneby.—*Astragalus* sect. *Famelicus* Sheld. in Minn. Bot. Stud. 1: 126, pro parte, sine descr. 1894.

Key to the Species of Subsect. Halliani

1. Pod (sessile or almost so) turgid but scarcely inflated, never bladdery, the fleshy valves becoming leathery, villosulous with spreading-incurved hairs; *herbage* commonly cinereous or canescent, ± densely villosulous; foothills, not over 7000 ft., s.-e. Colorado and immediately adjoining New Mexico and Oklahoma ..... 47. *A. puniceus*
1. Pod (stipitate or subsessile) glabrous, strigulose, or rarely thinly villosulous, commonly of papery texture, but if subsessile, or leathery in texture, then appressed-strigulose, and if thinly villosulous, then decidedly inflated and papery; if the herbage villosulous, then pod both inflated and papery; widespread, but near the range of the last montane, mostly over 7000 ft. (2)
2. Pod variable in degree of inflation and in texture of the valves, but if at the same time papery and bladdery, then villosulous and not over 1 (1.2) cm. in diameter, the calyx-teeth deltoid or subulate, 0.7–1.5 (2) mm. long, the plants flowering in summer and fall (late May onward); s.-w. New Mexico (Mimbres and Piños Altos ranges) n.- and n.-w.-ward ..... 46. *A. Hallii*
2. Pod greatly inflated and bladdery, the valves loosely strigulose, the body 1.1–1.6 cm. in diameter; *calyx-teeth* subulate, 2–3.5 mm. long; plants flowering in April, in fruit by May; San Andres Mountains, s.-centr. New Mexico ..... 48. *A. Castetteri*

46. ASTRAGALUS HALLII

Relatively coarse and leafy, rarely quite slender, diffuse or weakly ascending, variably strigulose or villosulous with fine, ascending, incurved, or subappressed,

sometimes partly sinuous hairs up to 0.25–0.8 (1) mm. long, the herbage green or cinereous, the leaflets commonly bicolored, yellowish- or brighter green and glabrous or medially glabrescent above; *stems* several or numerous, prostrate, decumbent, or assurgent, 1.5–5 dm. long, leafless and subterranean for a space of 1–18 cm., at emergence stouter and often divaricately branched at the first 1–few nodes, the main and lateral axes usually of about equal vigor, or the branches reduced to axillary spurs, rarely lacking; *stipules* (1.2) 2–7 mm. long, those at the lower nodes small, amplexicaul and connate into a scarious, glabrous, campanulate, truncate or bidentate sheath, the median and upper ones triangular-acuminate or lanceolate, subherbaceous, either strigulose or glabrescent dorsally, semiamplexicaul, or united by a low collar or stipular line; *leaves* 2–9 cm. long, the upper ones subsessile, with (11) 13–27 (31) oblong-oblanceolate, oblanceolate, or (especially in some lower leaves) obovate-cuneate to obcordate, obtuse, truncate, or retuse, flat or loosely folded leaflets (1.5) 3–13 mm. long; *peduncles* 3.5–11 cm. long, mostly as long or longer than the leaf; *racemes* at early anthesis rather densely, later more loosely (7) 10–28-flowered, the flowers loosely spreading, declined, or deflexed, then ± secund and retrorsely imbricated, the axis a little elongating, (1) 1.5–7 cm. long in fruit; *bracts* submembranous, lanceolate or narrowly ovate, 1.3–5 mm. long; *pedicels* at anthesis ascending, straight or somewhat arched outward, (1) 1.2–2.3 mm. long, in fruit either ascending, or strongly arched outward, or straight and abruptly divaricate, somewhat thickened, 2–4 mm. long; *bracteoles* 0–2, minute when present; *calyx* 5–9 mm. long, loosely strigulose or villosulous, the hairs white, fuscous, black, or mixed in varying proportions, the oblique disc 0.8–1.4 mm. deep, the submembranous, often purplish, deeply campanulate tube (4.4) 4.7–7 mm. long, (2.8) 3–4.3 (4.6) mm. in diameter, obliquely truncate at base or gibbous-saccate behind the pedicel, the deltoid or broadly triangular-subulate teeth 0.7–2.3 mm. long, the ventral pair commonly shortest; *petals* reddish-violet, pink-purple, or dull lilac to whitish tipped with lurid purple; *banner* ± sigmoidally arched, the claw incurved conformably with the base of the calyx-tube, the blade recurved through ± 40–45° (further in withering), broadly to narrowly rhombic-oblanceolate, -elliptic, or spatulate, deeply notched, (12.4) 13–18 (18.5) mm. long, (5.4) 6.4–9.6 (10) mm. wide; *wings* (11.5) 12–17 mm. long, the claws 5.1–7.5 mm., the narowly oblong, oblong-oblanceolate, or -obovate, obtuse, erose-emarginate, or (when broad) shallowly notched, nearly straight blades 7.2–11 mm. long, 2.1–3.4 mm. wide; *keel* 9–12 (12.3) mm. long, the claws (4.9) 5.2–7.2 mm., the half-obovate blades (4) 4.5–6.2 mm. long, (2.3) 2.5–3.3 mm. wide, abruptly incurved through 90–100° to the bluntly deltoid apex; *anthers* (0.5) 0.55–0.75 mm. long; *pod* spreading, ascending (when humistrate), declined, or deflexed, either stipitate or subsessile, the stout stipe varying from no longer than wide up to 4 (4.5) mm. long, the body variable in outline, barely tumescent to greatly inflated, 1.2–2.7 cm. long, (3) 4–12 mm. in diameter, the thinly fleshy, green or purplish, strigulose or more rarely villosulous valves becoming papery or thinly leathery; *ovules* 20–34; *seeds* brown or chestnut-brown, rarely purplish-black, ± pitted, dull, (1.9) 2.1–3.3 mm. long.

My concept of *A. Hallii* falls between that of Rydberg, who placed it apart from *A. famelicus* in a separate section of *Pisophaca*, and that of Jones, for whom the two species, together with *A. puniceus* and *A. Greenei*, formed parts of an inclusive and too loosely defined *A. gracilentus*. The history of *A. gracilentus*, which Jones misinterpreted, and of *A. Greenei*, both small-flowered plants more closely related to *A. flexuosus*, has been told under the heading of *A. flexuosus* var. *Greenei;* and *A. puniceus* is described below. It is agreed that *A. Hallii* and *A. famelicus* cannot be separated or defined in mutually exclusive terms and are best treated as no more than varietally distinct. The single differential character of Rydberg's sect. *Hallianae* was an oblong or linear, uninflated pod, as opposed to the swollen, ellipsoid to

obovoid fruit of its nearest kindred. The fruit of the typical phase of *A. Hallii* is ordinarily of narrowly oblong-elliptic or narrowly clavate outline and ± 5–6 mm. in diameter, but some otherwise identical plants from the Colorado Rockies have oblong-obovoid, considerably inflated pods up to 7.5–8.5 mm. in diameter (cf. *Crandall & Cowen 4569* from South Park, whence there are also narrow-fruiting forms). From herbarium annotations it is clear that Rydberg evaded the difficulty posed by such specimens by referring them to an imaginary species fashioned out of several discordant elements and labeled with the confused name *Pisophaca Greenei*. Turning to the pod of *A. famelicus*, we find it ordinarily inflated and ± 7.5–12 mm. in diameter, but in southern Apache County, Arizona, and even on the Flagstaff Plateau, where the species is especially common, narrowly ellipsoid pods varying from 5.5 to 7 mm. in diameter are encountered occasionally. The flowers of *A. Hallii* and *A. famelicus* are closely similar in form and fluctuate metrically around nearly the same standard length. The pod of genuine *A. Hallii* is papery when ripe and varies from glabrous to strigulose; that of *A. famelicus* is consistently pubescent but varies from papery to leathery. In short the normal or commonest types of fruit are not alike, but individual plants occur within the range of each species which bear fruits almost identical in form and texture. The slight but apparently useful dissimilarity in the pubescence, mentioned in the key below, seems to offer the nearest to a constant differential character; in the context of sect. *Scytocarpi* it is an inconsiderable criterion. In general *A. Hallii* is more diffuse in growth-habit, greener and more amply leafy, and its weaker peduncles are humistrate, so that the pods tend to fall at random angles to the raceme-axis, whereas those of *A. famelicus* are nearly always declined from ascending, commonly stiffer peduncles. In varietal status *A. famelicus* must resume its old epithet *fallax*.

Key to the Varieties of A. Hallii

1. Pod glabrous or thinly strigulose, the body narrowly oblong- or oblance-ellipsoid, (3) 4–7, more rarely up to 8.5 mm. in diameter; *herbage* green, rarely subcinereous, the vesture villosulous or loosely strigulose, the longest hairs up to 0.5–0.8 (1) mm. long; Rocky Mountains of Colorado and n. New Mexico ..... 46a. var. *Hallii*

1. Pod strigulose or rarely villosulous, the body usually distinctly inflated, obliquely ovoid or obovoid, rarely ellipsoid, (6) 7–12 mm. in diameter; *herbage* strigulose, often but not consistently cinereous, the longest hairs up to 0.2–0.4 mm. long or, if up to 0.6 mm. long, the pod always greatly inflated; w. New Mexico and Arizona ..... 46b. var. *fallax*

46a. Astragalus Hallii var. Hallii

Herbage commonly green, thinly pubescent, subcanescently so in arid sites, the stems glabrous or nearly so toward the base; *stems* decumbent or prostrate with ascending tips, mature plants forming, broad, low clumps; *leaflets* (13) 19–27 (31); *peduncles* commonly prostrate in fruit, the pods therefore humistrate and variably oriented, ascending, spreading, or declined; *petals* purple or reddish-violet, with paler claws and pale, striate eye in the banner; *pod* stipitate, the stipe 1–2 mm. long (concealed by the calyx), the body narrowly oblong-ellipsoid, or widest above the middle and thus subclavately ellipsoid, straight or a trifle incurved, (12) 13–24 (27) mm. long, (3) 4–7 (8.5) mm. in diameter, cuneate or attenuate at base, abruptly cuspidate-beaked, a little obcompressed, either rounded or shallowly and openly grooved dorsally, the ventral suture thick and prominent, the valves becoming rather stiffly papery, stramineous or brownish, glabrous or strigulose with scattered white or rarely fuscous hairs up to 0.2–0.3 mm. long; *ovules* 20–30.—Collections: 36 (vii); representative: *W. A. Weber 4892* (CAS, SMU, TEX, WS); *Clokey 3550* (CAS, NY, TEX); *Ripley & Barneby 7197* (CAS, NY, RSA), *10,417* (CAS, NY, RSA); *C. F. Baker 376* (NY).

Dry hillsides, gravelly clay flats, mountain meadows, nearly always among sagebrush, 7650–10,000 feet, widely dispersed and rather common in the valleys and parks of the Colorado Rocky Mountains about the headwaters of the Grand, Gunnison, Dolores and South Platte Rivers and the Rio Grande, extending south to both slopes of the Sangre de Cristo Mountains in Taos and Colfax Counties, New Mexico.—Map No. 18.—June to September.

ASTRAGALUS HALLII (Elihu Hall, 1822–1882, with J. P. Harbour and C. C. Parry, a pioneer botanist in the centr. Colorado Rockies in 1862) Gray in Proc. Amer. Acad. 6: 224. 1864.—"Valleys of the Rocky Mountains of Colorado Territory, lat. 39–41°, coll. Hall & Harbour, no. 121."—Holotypus, GH! isotypi, G, K, MO, NY, OXF, P, PH, US!—*Tragacantha Hallii* (Gray) O. Kze., Rev. Gen. 945. 1891. *A. gracilentus* var. *Hallii* (Gray) Jones, Contrib. West. Bot. 8: 13. 1898. *Homalobus Hallii* (Gray) Rydb. in Bull. Torr. Club 32: 667. 1905. *Pisophaca Hallii* (Gray) Rydb. in N. Amer. Fl. 24: 326. 1929.

Astragalus Shearii (Cornelius Lott Shear, 1865–1956, distinguished mycologist and plant pathologist) Rydb. in Bull. Torr. Club 31: 562. 1904.—"COLORADO: Twin Lakes, 1896, *C. L. Shear 3317*."—Holotypus, collected August 21, 1896, NY! isotypi, RM, US!—*Atelophragma Shearii* (Rydb.) Rydb. in op. cit. 32: 660. 1905 *("Shearis")*.

46b. ASTRAGALUS HALLII var. FALLAX

Stems and herbage cinereous, more rarely greenish; *stems* either diffuse or assurgent, commonly more rigid and wiry than in var. *Hallii; leaflets* (11) 13–23 (25); *peduncles* incurved-ascending to suberect, not or seldom humistrate in fruit, the pods mostly declined or deflexed, exceptionally ascending; *petals* variable in color, bright or pale purple, or whitish tipped or suffused with dull lilac or lurid purple; *pod* stipitate or subsessile, the stipe varying from obscure and no longer than wide up to 4 (4.5) mm. long, the body either erect in the plane of the stipe or incurved from its junction with the stipe, obliquely ovoid to broadly, rarely narrowly ellipsoid, slightly to greatly inflated, (1.3) 1.6–2.7 cm. long, (6) 7–12 mm. in diameter, truncately rounded or broadly turbinate at base, terete or a little compressed either dorsiventrally or laterally, either esulcate with both sutures convex (but the thickened, prominent ventral one commonly less convex than the dorsal) or (especially when incurved) openly sulcate ventrally, the stiffly papery or leathery valves strigulose or less often villosulous with white, sometimes fuscous hairs up to 0.15–0.3 mm. long; *ovules* (24) 28–34.—Collections: 37 (ii); representative: *Jones 3980* (OB, POM, NY); *Lt. Schallert in 1943* (CAS, ID, NY, TEX, WIS, WS); *F. W. Gould 3692* (CAS, NY); *Mex. Bound. Surv. 266* (NY).

Stony flats and ridges in yellow pine forest, coming out into open places in oak-juniper woodland, 5500–7200 (reportedly 8500) feet, mostly in dry granitic or volcanic soils, common and locally plentiful in the Mogollon mountain-system, from Flagstaff Plateau southeast to the Piños Altos and Mimbres Mountains, central Arizona to southwestern New Mexico; apparently somewhat isolated on Mount Taylor, Valencia County, New Mexico; and on the Santa Catalina Mountains, Pima County, Arizona.—Map No. 18.—Late May to September.

ASTRAGALUS HALLII var. FALLAX (Wats.) Barneby in Leafl. West. Bot. 9: 91. 1960, based on *A. fallax* (deceptive, formerly confused with kindred species) Wats. in Proc. Amer. Acad. 20: 362. 1885.—"In Western New Mexico, collected by Wright (n. 1004) and by Sitgreaves, and at Flagstaff near the San Francisco Mountains, Arizona, by Rusby, and also by Lemmon."—Lectotypus: *Charles Wright 1004*, collected in New Mexico, probably near Santa Rita del Cobre, in 1851, GH! isotypi, K, NY, P, PH, UC, US (2 sheets)!—*Astragalus famelicus* (starved) Sheld. in Minn. Bot. Stud. 1: 23. 1884, a legitimate substitute; non *A. fallax* Fisch., 1853. *A. gracilentus* var. *fallax* (Wats.) Jones, Contrib. West. Bot. 8: 14. 1898. *Pisophaca famelica* (Sheld.) Rydb. in N. Amer. Fl. 24: 326. 1929.

The original description of *A. fallax* Wats. was based on several collections from western New Mexico and central Arizona, which demonstrate collectively almost the whole known gamut of variation except for the narrow fruits mentioned in the discussion of *A. Hallii* above. Watson's epithet referred to the fact that the plants gathered by Wright and Bigelow near the copper mines had been misidentified by Gray, and later by Torrey, as *Phaca Fendleri*, a much smaller-flowered plant now believed to represent no more than a minor variant of *A. flexuosus*. The Wright collection, singled out by Watson for special mention, has been chosen as lectotypus, thereby narrowing strict application of the name to the form of var. *fallax* found in the mountains of southwestern New Mexico. This differs slightly from most examples of the variety from Arizona in having an exceptionally thin-walled pod beset with spreading rather than appressed hairs, and it is possible that further collections will demonstrate a need to

recognize two entities. For the moment, however, we lack well-ripened fruits from the mountains of Arizona bordering on New Mexico, and the racial situation in the area where intermediate forms are most likely to occur is thus not clear. The stipe of var. *fallax* is variable in length, in some populations reduced to an obscure necklike structure no longer than wide, in others prominently developed and up to 4.5 mm. long. The longest stipes occur mostly in Coconino County, Arizona, but the shortest of all are present in the same region. In southwestern New Mexico the stipe is commonly ± 1 mm. long.

A remarkable plant, ostensibly collected at Bryce Canyon, Garfield County, Utah, in June of 1932 (*K. E. Wright B32/162*, US) deserves special notice. It resembles *A. Hallii* var. *fallax* closely in habit of growth and in form and size of the corolla, but the stems and leaves are beset with loosely ascending or horizontal hairs up to ± 0.4 mm. long, the leaflets are relatively few (11–13 in most leaves), and the 20 or perhaps 22 ovules are less numerous than usual in var. *fallax*. The vesture is quite suggestive of the nearly sympatric *A. subcinereus*, but the flowers are very much larger. Material with fruits may prove to belong to an undescribed variety or close ally of *A. Hallii*.

47. Astragalus puniceus

Relatively robust, diffuse, the leaves and calyces villosulous with fine, loosely incurved-ascending or largely curly hairs up to 0.4–0.9 (1.2) mm. long, the mature herbage greenish-gray, the young parts canescent, the leaflets somewhat bicolored, brighter green and often less densely pubescent above than beneath (the whole plant except the pod exceptionally glabrous); *stems* several or numerous, (1.5) 2–5 dm. long, decumbent and radiating to form broad, depressed clumps, simple and buried for a space of 3–10 (17) cm., upon emergence stouter and usually bearing at the first exposed nodes several branches as long as the main axis (these sometimes reduced to sterile spurs), exceptionally simple, flexuous or zigzag distally; *stipules* 2–6 mm. long, dimorphic, the lowest small, connate into a subtruncate or bidentate, papery, brownish sheath, the median and upper ones herbaceous becoming papery in age, connate through half their length or the uppermost free nearly or quite to the base, with deltoid or lanceolate, erect or deflexed blades; *leaves* (2) 3–11 cm. long, the lower ones shortly petioled, the rest subsessile, with (7) 13–27 broadly to narrowly elliptic, oblong-oblanceolate, obovate-cuneate, or linear-oblong, mostly truncate-emarginate, sometimes obtuse, flat or loosely folded leaflets (3) 5–16 mm. long; *peduncles* commonly stout, ascending, straight or nearly so, 2–8 (11.5) cm. long; *racemes* 5–19 (27)-flowered, rather dense in early anthesis, the flowers ascending, horizontal in age, the axis somewhat elongating, (0.5) 1.5–6.5 cm. long in fruit; *bracts* lanceolate, 1.5–6 mm. long; *pedicels* at anthesis ascending and 1–1.8 mm. long, in fruit arcuate-recurved, somewhat thickened, 1.5–2.9 mm. long; *bracteoles* 2, rarely 0; *calyx* 6–10.6 mm. long, villosulous like the herbage with mixed black and white hairs, the oblique disc 0.8–1.4 mm. deep, the campanulate or broadly cylindro-campanulate tube 4.9–8 mm. long, 3.2–4.6 mm. in diameter, the subulate, triangular-subulate, or rarely broadly triangular teeth 1.1–2.8 mm. long, the ventral pair commonly shortest and broadest; *petals* either bright pink-purple or pallid and only lilac-tinged; *banner* recurved through ± 45°, ovate-cuneate, rhombic-ovate, or elliptic-oblanceolate, 13.4–21 mm. long, 7–12 mm. wide; *wings* 13.5–18 mm. long, the claws 6.2–7.5 mm., the oblong-oblanceolate, quadrately oblong, rarely linear-oblong, obtuse, erose, or (when broad) obliquely emarginate, straight or slightly incurved blades 8.5–13 mm. long, 2.3–4.3 mm. wide; *keel* 10.4–14 mm. long, the claws 5.8–8 mm., the half-obovate blades 5.4–7.5 mm. long, 2.6–3.8 mm. wide, incurved through 85–95° to the bluntly deltoid apex; *anthers* 0.5–0.8 mm. long; *pod* horizontally spreading or declined, sessile, obliquely oblong- or ovoid-ellipsoid, 1.5–2.4 cm. long, (4.5) 5–9.5 mm. in diameter, turgid or somewhat inflated, gently incurved, rounded or cuneately obtuse at base, contracted distally into a short, laterally compressed, triangular, cuspidate beak, otherwise subterete or a trifle obcom-

pressed, the thick, nearly straight to concavely arched ventral suture either prominent or depressed into a shallow groove, the more slender dorsal suture only rarely depressed, the fleshy, loosely strigulose or villosulous valves becoming leathery, transversely reticulate, brownish or stramineous; *ovules* 25–36; *seeds* (seldom seen) purplish-brown, pitted but sublustrous, ± 3 mm. long.

Key to the Varieties of A. puniceus

1. Petals bright pink-purple; *vesture* of stems and herbage alike, villosulous; *pod* nearly always brightly red-mottled; headwaters of the Canadian River, extreme n.-w. New Mexico and adjoining Colorado and Oklahoma ..... 47a. var. *puniceus*
1. Petals whitish tinged with dull lavender or sordid purple; *vesture* of two sorts, that of the stems appressed, that of the herbage villous; *pod* not mottled; upper Rio Grande Valley in Taos County, New Mexico ..... 47b. var. *Gertrudis*

47a. Astragalus puniceus var. puniceus

Leaflets (7) 17–27; *bracts* herbaceous; *bracteoles* nearly always present; *flowers* variable in size, the banner commonly about 16–21 mm., more rarely only 13.5 mm. long; *pod* mostly oblong-ellipsoid, (4.5) 5–8 mm. in diameter.—Collections 14 (i); representative: *J. Ewan 13,180* (RSA); *Eggleston 20,076, 7, & 8* (NY); *Ripley & Barneby 7624* (CAS, RSA, UTC).

Low bluffs, sandy mesas, fallow fields, and stabilized dunes, 4700–7000 feet, locally plentiful about the sources of the Canadian River in extreme northeastern New Mexico, adjoining Colorado, and on Black Mesa at the western tip of the Oklahoma Panhandle.—Map No. 18.—May to July.

Astragalus puniceus (red, of the petals, a misnomer) Osterh. in Muhlenbergia 1: 140. 1906.—"Collected at Trinidad, Las Animas county, Colorado, June 28, 1898, no. 1737."—Holotypus, RM! isotypi, NY, POM, RM! *Xylophacos puniceus* (Osterh.) Rydb. in Bull. Torr. Club 40: 48. 1913. *Pisophaca punicea* (Osterh.) Rydb. in N. Amer. Fl. 24: 328. 1929.

Astragalus gracilentus var. *exsertus* (exserted, of the petal-claws) Jones, Rev. Astrag. 195, Pl. 44. 1923.—"Trinidad, Colorado, No. 7, Geo. E. Osterhout, 1898."—Holotypus (= isotypus of the preceding), POM!

There can be no question that *A. puniceus* and *A. Hallii* are very closely related, and because of the variation encountered in each it is difficult to find characters of a high order which are consistently differential. In practice the Trinidad milk-vetch, var. *puniceus,* is readily distinguished from var. *Hallii* by its fleshier, ultimately thicker-walled and more rigid pod, and by its more densely and loosely pubescent foliage. Where they appear (from the map) to approach each other in range, they occupy different life-zones, and *A. puniceus* comes into flower a month or more earlier.

The Trinidad milk-vetch is a rather coarse astragalus, but a showy one when in full bloom, the petals being bright pink-purple as in many species of *Hedysarum,* hardly red as suggested by the epithet. Within its small range of dispersal in Colorado and New Mexico, the flowers are uniformly large; but on the slopes and summit of Black Mesa at the western extremity of the Oklahoma Panhandle occurs a local race, similar in all details of fruit and pubescence, but differing in the shorter calyx and petals. This form may deserve varietal rank, but its recognition must await deliberate search for intermediate colonies. For sake of completeness the characters of the typical and Black Mesa forms, as known up to the present, may be contrasted as follows:

a. Calyx 9.3–10 mm. long, the tube 7–8 mm., 4.2–4.6 mm. in diameter; *banner* 15–21 mm. long; *keel* 13–14 mm. long, the claws 6.5–8 mm., the blades 7–7.5 mm. long, 3.3–3.8 mm. wide; Colorado and New Mexico ..... var. *puniceus* (typical)

a. Calyx 6–8.1 mm. long, the tube 4.9–6 mm., 3.5–3.9 mm. in diameter; *banner* 13.4–16.5 mm. long; *keel* 10.4–11.5 mm. long, the claws 5.8–6.6 mm., the blades 5.4–5.8 mm. long, 2.6–3 mm. wide; w. Oklahoma ..... var. *puniceus* (Black Mesa)

Representative of the Black Mesa form are: *Waterfall 9077, 10,735* (OKLA); *G. W. Stevens 468* (NY); *Goodman & Waterfall 4841* (OKLA).

The Trinidad milk-vetch was collected first in the Raton Mountains, in 1867, by an English traveler, Dr. William M. Bell (BM).

47b. Astragalus puniceus var. Gertrudis

Leaflets 13–21; *bracts* submembranous; *bracteoles* apparently 0; *flowers* rather small, the calyx-tube 5.7–7.1 mm. long, 3.2–3.8 mm. in diameter, the banner 14.8–17.8 mm. long; *keel* 10.7–12.7 mm. long, the claws 5.8–7 mm., the blades 5.3–6.5 mm. long, 2.9–3.4 mm. wide; *pod* a little plumper, mostly ovoid-ellipsoid, 6.5–9.5 mm. in diameter.—Collections: 2 (i); representative: *Ripley & Barneby 7549* (CAS, RSA, UTC).

Dry banks and gravelly benches among piñons and junipers, about 7000 feet, apparently rare and local, known only from the Rio Grande Valley in southern Taos County, New Mexico.—Map No. 18.—May and June.

Astragalus puniceus var. Gertrudis (Greene), stat. nov., based on *A. Gertrudis* (Emily Gertrude Halbach, 1869–1939, teacher, collector, botanical artist, wife of A. A. Heller) Greene, Leaflets 2: 43. 1910.—"Taos Co., New Mexico, 27 May, 1897, collected by Mr. & Mrs. Heller, n. 3598."—Holotypus, ND! isotypi, DS, NY, OB, P, US, WS!—*Pisophaca Gertrudis* (Greene) Rydb. in N. Amer. Fl. 24: 326. 1929.

In the field the immediately striking characters of var. *Gertrudis* are the color of the petals, which wholly lack the brilliance of typical *A. puniceus,* and the absence of mottling on the pod; but these amount to little more than a single difference, a dilution of anthocyanic pigment in the plant-tissues. On closer examination the contrasting orientation of the hairs on the stems and herbage provides a secondary differential character, although this is open to suspicion in the context of sect. *Scytocarpi,* in which the vesture is uncommonly variable in quality and amount. A premonition of variation in pubescence, which must be expected as var. *Gertrudis* becomes better known, is afforded by one individual plant of the type-series (NY) in which the entire plant, except for the villosulous pod, is glabrous. In the form of the fruits and flowers var. *puniceus* and var. *Gertrudis* are almost identical, and it might have been preferable to evaluate the latter as a minor variant. However, if the ranges of the two forms are separated, as they now appear to be, by the massive barrier of the Sangre de Cristo Mountains, it is reasonable to regard them as geographic varieties.

48. Astragalus Castetteri

Caulescent perennial with a woody taproot and shallowly buried root-crown or caudex, strigulose nearly throughout with fine, straight, appressed hairs up to 0.3–0.45 mm. long, the herbage green or cinereous when young, the leaflets more or less bicolored, brighter green but either glabrous or thinly pubescent above; *stems* several or numerous, diffuse and incurved-ascending, 2–4 dm. long, leafless and subterranean for a space of 1–12 cm., spurred or shortly branched at 1–5 nodes preceding the first peduncle, floriferous upward from near or a little below the middle; *stipules* 2–7 mm. long, strongly dimorphic, the lowest ones amplexicaul and connate into a papery, pallid or brownish, subtruncate or obtusely bidentate, eventually glabrous and fragile sheath, the upper ones longer, herbaceous, deltoid-acuminate or lanceolate, amplexicaul but only very shortly or obscurely connate, strigulose dorsally, the blades mostly erect; *leaves* (3.5) 5–10 cm. long, petioled but the uppermost only shortly so, with (11) 13–25 oblong-elliptic or (in some lower leaves) obovate, emarginate, flat or loosely folded leaflets (2.5) 5–14 mm. long; *peduncles* rather stout, 4.5–8 cm. long, a little longer or shorter than the leaf; *racemes* 8–18-flowered, rather dense at early anthesis, the flowers early spreading and declined in age, the axis not greatly elongating, 2–5 cm. long in fruit; *bracts* submembranous, narrowly lance-acuminate, 2–4 mm. long; *pedicels* at anthesis slender, ascending, 0.8–1.5 mm. long, in fruit a little thickened, recurved, or straight and divaricate, 2–3.5 mm. long, tardily disjointing with the fruit; *bracteoles* 0; *calyx* 7.9–10 mm. long, loosely strigulose or villosulous with incurved and ascending, black or mixed black and white hairs, the strongly oblique disc 1.2–1.6 mm. deep, the deeply campanulate or subcylindric, subtumid, purple-tinged tube 5.8–7.2 mm. long, 3.5–4 mm. in diameter, the subulate teeth 2–3.5

mm. long, the whole becoming papery, marcescent; *petals* pale purple, drying dull lavender; *banner* recurved through 45°, broadly rhombic-oblanceolate or -spatulate, openly notched, 14–18.7 mm. long, 7.4–9 mm. wide; *wings* 14.2–17.6 mm. long, the claws 7–8.1 mm., the narrowly oblong-elliptic, obtuse, almost straight blades 8–10.2 mm. long, 2.4–2.8 mm. wide; *keel* 11–14.4 mm. long, the claws 6.2–7.8 mm., the half-obovate blades 5.2–7.6 mm. long, 2.8–3.1 mm. wide, abruptly incurved through 90° to the exactly or bluntly deltoid apex; *anthers* 0.65–0.75 mm. long; *pod* widely spreading or declined, stipitate, the stipe 1.5–3 mm. long set at an oblique angle to the subsymmetrically ovoid-acuminate or -ellipsoid, bladdery-inflated body, the body 2.2–2.8 cm. long, 1.1–1.6 cm. in diameter, cuneately contracted at base into the stipe, narrowed distally into a triangular-acuminate, laterally compressed, almost erect beak 4–8 mm. long, otherwise subterete but shallowly sulcate ventrally, the sutures both filiform, the thin, red-mottled, loosely strigulose or subvillosulous valves becoming papery, stramineous, subdiaphanous, somewhat lustrous, finely cross-reticulate, smooth within, not inflexed, the funicular flange 0.7 mm. wide; *dehiscence* apical, through the beak; *ovules* 22–26; *seeds* dark brown, minutely pitted or almost smooth, dull, 2.2–2.8 mm. long.—Collections: 3 (o); representative: *Hershey 2007* (RM).

Dry slopes in piñon forest, 5000–5500 feet, locally common but known only from the west slope of the San Andres Mountains (Ash Canyon; Rope Springs), northeastern Doña Ana County, New Mexico.—Map No. 18.—April and May.

ASTRAGALUS CASTETTERI (Edward Franklin Castetter, 1891–), sp. nov., *A. Hallii* et praesertim ejus var. *fallaci* (Wats.) Barneby arcte affinis, a var. *fallacis* formis legumine vesicario praeditis differt dentibus calycinis elongatis (2–3.5 nec 0.7–2 mm. longis), legumine ipso maxime inflato (1.1–1.6 cm. nec 0.7–1.2 cm. diametro) striguloso nec villosulo, insuper anthesi vernali (Aprili Maioque mensibus) nec solstitiali et serotino (in Septembrem usque).—NEW MEXICO: common under piñon trees, Rope Springs, Doña Ana County, April 27, 1937, fl. & fr. jun., *A. L. Hershey 2005*.—Holotypus, RM! isotypi 6 distributuri. Ash Canyon, San Andres Mountains, Doña Ana County, May 24, 1952, fr. maturo, *E. F. Castetter 5964*. Cotypus in herb. Univ. New Mex!

The Castetter milk-vetch is closely related to the typical phase of the variable *A. Hallii* var. *fallax*, which it resembles in the thin texture and inflation of the pod. It may have arisen from var. *fallax* through a mutation which involved some small morphological modifications coinciding with a reversion to vernal flowering. The species first became known to me through Professor Castetter's specimen cited above as the fruiting cotypus, but it was collected first by Hershey in 1937. I am indebted to Professor Porter for permission to analyze the unmounted type-set in the Rocky Mountain herbarium that he had set aside for further study.

XI. Sectio GENISTOIDEI

Caulescent perennials, with a taproot and either superficial or buried root-crown; *vesture* either basifixed or dolabriform; *stipules* all, or at least the lower ones connate; *leaves* imparipinnate, with up to 21 leaflets, these all jointed, or all but the terminal one jointed, or the lateral (commonly decurrent) leaflets reduced in size or number, or wanting and some or all leaves reduced to the naked rachis or a phyllodium; *flowers* loosely racemose, declined in age, small, the banner 6–13.5 mm. long; *pedicels* persistent or tardily disjointing with the fruit; *calyx-tube* campanulate; *petals* whitish, ochroleucous, purplish, rarely purple, little and often irregularly graduated, the keel-tip obtuse, subacute, or narrowly triangular and beak-like; *pod* pendulous (or refracted to vertical), sessile, persistent, linear, linear-lanceolate, -oblanceolate, or narrowly oblong in profile, straight or nearly so, laterally compressed and 2-sided, unilocular (subunilocular in one rare form), the valves papery; *dehiscence* apical and downward through both sutures, the valves somewhat elastically coiling; *ovules* 6–26.—Spp. 3, xerophytes (except *A. diversifolius*), widespread through the Rocky Mountains and intermontane United States,

from Alberta and British Columbia to Colorado, the Black Hills of South Dakota, west to the Cascade Range in Washington, to Idaho, eastern Nevada, southern Utah, and central Arizona.

ASTRAGALUS sect. GENISTOIDEI (T. & G.) Barneby in Leafl. West. Bot. 5: 25. 1947, based on *Homalobus* sect. *Genistoidei* T. & G., Fl. N. Amer. 1: 351. 1838 *("Genistoideae").*—Sp. typica: *Homalobus campestris* Nutt. = *A. convallarius* Greene.

Homalobus sect. *Campestres* Rydb., Fl. Colo. 208. 1906, & in Bull. Torr. Club 50: 261. 1923.—Sp. typica: *H. campestris* Nutt. = *A. convallarius* Greene.

The sect. *Genistoidei* is equivalent in scope to Rydberg's sect. *Campestres* of *Homalobus,* and the circumscription has been only slightly modified since my revision (Barneby, 1947, l.c.) in order to exclude the free-stipuled *A. lancearius, A. titanophilus,* and *A. xiphoides,* now transferred to sect. *Lonchocarpi.* The *Genistoidei* formed a small part of Jones's heterogeneous sect. *Homalobi* (1923).

The section consists of two groups of species, one composed of the polymorphic and pluriracial *A. miser,* characterized by a superficial root-crown and a basal tuft of leaves, the other of the more highly modified *A. convallarius* and its rare mesophytic derivative *A. diversifolius,* in which the stems are all fertile, leafless at base and nearly always branched upward, and arise from a more or less deeply buried point of renewal. The flowers of *A. miser* are noteworthy for the triangular or triangular-acuminate, often very prominent keel-tip, whereas those of *A. convallarius* have all the petals of about equal length and strongly incurved. The pods of some forms of each of the principal species are nearly identical in form and structure, so that they are manifestly close relatives, despite modifications involving the flower-shape and the position of the resting buds.

The affinities of the *Genistoidei* can be traced in several directions: through *A. convallarius* to the *Pseudogenistoidei* of sect. *Lonchocarpi,* which have similarly incurved petals but large, veiny, free stipules at the base of the stems, and less directly to the *Scytocarpi,* similar in the stipules but differing in the nearly always terete pod; and through *A. miser* to *A. Bourgovii* of sect. *Ervoidei,* which differs in its stipitate few-ovulate pod. Some malpighian-haired forms of *A. miser* suggest an evolutionary stage prefiguring the greatly specialized, acaulescent *Drabellae.*

Key to the Species of Sect. Genistoidei

1. Root-crown or caudex superficial; *leafy spurs present* on the root-crown or caudex-branches, forming a basal tuft (2)
   2. Keel 6–10.5 mm. long, as long or commonly a trifle longer than the wings, with triangular or lance-acuminate, often beaklike apex; *stems* mostly simple ..... 49. *A. miser*
   2. Keel 3–5.5 mm. long, much shorter than the wings, deltoid and very obtuse at apex; *stems* all freely branched; cf. *A. (Ervoidei) vexilliflexus.*
1. Root-crown or caudex subterranean; *no basal leafy tuft,* all stems fertile, simple and naked at base, branching upward (3)
   3. Banner recurved through more than 90°; *ovules* 10–26 (4)
      4. Pod commonly linear-lanceolate, linear, or linear-oblanceolate in profile, 2.5–5 cm. long, 2.5–3.3 mm. in diameter, 8–18 times longer than wide, rarely (in s.-w. Utah and adjoining Nevada) relatively shorter and broader but the ovules then 18–26; *leaflets* and leaf-rachis usually very narrow, the leaflets when present usually folded and of stiff texture; *plants* of dry soil, common and widespread ..... 50. *A. convallarius*
      4. Pod narrowly oblong, mostly 1–1.7 cm. long, 3–3.7 mm. in diameter, 4–6 times longer than wide; *ovules* 10–16; *leaflets* and leaf-rachis commonly expanded into flat, grasslike blades of relatively thin texture; plants of moist meadows and streambanks, local in s. Idaho, n. Utah, and perhaps w. Wyoming ..... 51. *A. diversifolius*
   3. Banner recurved through ± 50°; *ovules* 4–8; cf. *A. (Scytocarpi) wingatanus.*

49. ASTRAGALUS MISER

Low and closely tufted, or taller and diffuse, with a tough woody taproot and pluricipital root-crown or ultimately branched suffruticulose caudex, thinly to very densely pubescent with appressed or ascending, mostly straight, rarely sinuous or curly, basifixed or dolabriform hairs up to 0.3–1 (1.25) mm. long, the herbage green, cinereous, or silvery-silky (-villous), the leaflets either glabrous or pube-

scent above; *stems* usually numerous, arising from buds on the root-stock at or a little above soil-level, commonly of 2 sorts: *sterile spurs* with inhibited internodes forming a basal leafy tuft, these sometimes issuing from the lowest, approximate nodes of the current season's stems rather than directly from the caudex; and *fertile stems,* either decumbent or ascending, 1–35 cm. long, with at least 1 and commonly several developed internodes; *stipules* 1.5–9 mm. long, all or at least the lowest papery-membranous, pallid or brownish (the uppermost sometimes with herbaceous blades), amplexicaul and connate into a bidentate, often loose sheath, the lowest ones small, the upper progressively longer and more shortly united, the uppermost often joined by a low collar or stipular line, with lance-acuminate, erect or spreading blades; *leaves* 1.5–20 cm. long, with slender but upwardly sometimes short petiole and (3) 7–21 opposite or often scattered, moderately distant or remote leaflets varying from linear-filiform and closely folded to flat and broadly oval in outline, acute or (when broad) obtuse or even subemarginate, the lateral ones articulate but sometimes obscurely so, the terminal one either similar to the rest and contiguous to the uppermost pair, or very commonly remote from them and then either jointed or tapering downward and decurrent into the rachis; *peduncles* slender, mostly incurved-ascending, (1) 2–13 cm. long, either shorter or a little longer than the leaf; *racemes* loosely, remotely, or in early anthesis subcompactly 3–20 (25)-flowered, the flowers early spreading or somewhat declined, the axis ± elongating, 1–14 cm. long in fruit; *bract* membranous, ovate or lanceolate, (0.6) 1–4 mm. long; *pedicels* at anthesis ascending or arched outward, 0.8–2.7 mm. long, in fruit commonly twisted at base and irregularly spreading, contorted, or refracted, 1.2–3 mm. long; *bracteoles* commonly 0, minute when present; *calyx* 2.3–6 mm. long, strigulose with white, black, or mixed hairs, the symmetric disc 0.4–1 mm. deep, the campanulate tube 1.7–4.2 mm. long, 1.6–3 (3.5) mm. in diameter, the subulate or triangular-subulate teeth 0.5–2.6 mm. long, the whole becoming papery, marcescent unruptured; *petals* whitish or ochroleucous, often veined or suffused with dull lilac, sometimes all clear lilac or pink-purple, the keel-tip in any case maculate; *banner* recurved through 40–90°, broadly ovate- to suborbicular-cuneate, notched, 5.9–13 mm. long; *wings* 5.3–10.6 mm. long, the narrowly oblong to oblong-obovate, sometimes broadly obovate, obtuse or rarely truncate blades 4–7.5 mm. long, both incurved but the left one more abruptly so and its inner margin infolded; *keel* almost always a trifle longer than the wings, 5.9–10.7 mm. long, the blades 3.8–7 (8.5) mm. long, oblong-elliptic in the lower ⅔, thence abruptly incurved through 85–95 (exceptionally only 45)° into the triangular, commonly narrowly triangular to lance-acuminate, beaklike apex; *anthers* 0.3–0.6 (0.7) mm. long; *pod* pendulous, sessile or substipitate (the stipe, when present, less than 1 mm. long), the body in profile exactly linear, linear-oblong, or very commonly broadest below the obliquely triangular apex and then narrowed downward into the calyx and thus oblanceolate or linear-oblanceolate, 1.1–2.5 cm. long, 1.9–4 mm. in diameter, straight or a little arched downward (and often a trifle incurved distally, hence obscurely sigmoid), strongly compressed laterally either when young or permanently (the flat sides sometimes distended by the seeds and becoming low-convex at maturity), bicarinate by the salient but filiform sutures, the green, sometimes purple-speckled or -mottled, glabrous or strigulose valves becoming papery, brown or stramineous, faintly reticulate, not inflexed; *dehiscence* apical and downward, sometimes elastically, through both sutures, the valves coiling outward to expel the seeds; *ovules* 6–19; *seeds* ochraceous, brown, or pale greenish, nearly always purple-speckled, the purple spots sometimes very numerous and confluent into a deep plum-purple ground, the testa smooth or very sparsely pitted, scarcely lustrous, 1.8–2.9 mm. long.

A discursive account of the complex racial situation in *A. miser* has been published recently (Barneby, 1956, p. 478–484), and only a few remarks of a general nature seem called for in these pages. The weedy milk-vetch is one of the commonest astragali of the Rocky Mountains, locally abundant upward through the sagebrush foothills into the main forest belt; but only a few forms, because of the small size and usually dingy coloring of the flowers, make any conspicuous contribution to the flora. The species, a near relative of *A. convallarius,* resembles it closely in the form of the pod, although this is usually shorter. The loose tuft of basal leaves arising from a superficial root-crown or caudex, the nearly always more ample foliage, and the triangular or beaklike keel-tip quickly distinguish it. In the northern Rocky Mountains *A. Bourgovii,* especially when in flower only, is sometimes difficult to separate from purple-flowered forms of *A. miser,* but the few ovules and distinctly stipitate, ordinarily black-hairy pod are diagnostic.

The weedy milk-vetch is of great interest since it embraces some varieties with basifixed pubescence and others with hairs all or largely dolabriform, a situation duplicated in *A. (Ervoidei) Kentrophyta.* The transition from a strictly basal, through a basal but lateral, into a suprabasal point of attachment can be traced from hair to hair in *A. miser* var. *praeteritus,* as also in typical *A. Kentrophyta.* In the Old World the type of hair-attachment has traditionally, since the time of Bunge's monograph, been accepted as a criterion of subgenera in *Astragalus;* obviously it can serve no such purpose in America.

There are conflicting reports as to the toxicity of *A. miser;* some forms at least must be dangerous locoweeds. In the Cache National Forest, Utah, it has been found responsible for the death of cattle on the range, and small quantities fed experimentally to sheep had fatal results (Wayne Binns, Veterinarian with U.S. Dept. Agr., Animal Disease and Parasite Branch, personal communication). According to Beath (in Ecology 17: 692. 1936), *A. hylophilus* (= probably our var. *oblongifolius*) is an important stock poison in parts of southern Wyoming (confirmed by *C. L. Porter* in herb., *No. 3482,* NY, RM. TEX). Beath found the species only on two similar geological formations (the Hanna and Bishop conglomerates) and suggested a correlation between toxicity and bedrock. According to my own observations in Montana, Utah, Colorado, and elsewhere, the various forms of *A. miser* occur on a great variety of soils, as already remarked by Graham (in Ecology 18: 171. 1937) of var. *oblongifolius* in the Uinta Basin. A collector of var. *praeteritus* (*J. E. Schrauz 107,* RSA, USFS) describes it as providing "good forage for cattle and sheep," and var. *oblongifolius* is often browsed, even where innocuous feed is plentiful, at least in the Colorado Rocky Mountains. Far northward var. *serotinus* has been stigmatized (*Eastham 13,515,* WS) as the cause of "more losses in livestock in British Columbia than all other poisonous plants combined." Evidently much remains to be learned concerning the poisonous races of *A. miser.* It seems probable, however, that the toxic principle varies in intensity from one population (or one variety) to another, and possibly also at different stages of growth.

Key to the Varieties of A. miser

1. Pubescence of the herbage composed wholly of basifixed hairs (2)
   2. Leaflets equally pubescent on both faces, the herbage silvery or cinereous; *flowers* rather large, the calyx (4.2) 4.6–6 mm. long, the keel (7.8) 8.6–10.7 mm. long; *petals* lilac or pink-purple. Pod pubescent. N.-e. Washington to n.-w. Montana and adjacent Canada ..... 49e. var. *miser*
   2. Leaflets commonly glabrous or medially glabrescent above, but if equally pubescent on both sides then the *flowers* much smaller; *flowers* variable in size, but if as large as the foregoing then whitish except for the maculate keel-tip and the pod then glabrous; widespread (3)
      3. Leaflets few, (3) 7–11 to the leaf; *flowers* very small, the banner 6–8 mm. long; *pod* almost exactly linear in profile, strigulose; *stems* 1–11 cm. long; *ovules* 8–12; s.-w. Wyoming, s.-e. Idaho, n.-w. Utah, and n.-e. Nevada. ..... 49b. var. *tenuifolius*
      3. Leaflets more numerous, 11–21 (except in some early leaves); either the *flowers* larger, or the *pod* oblanceolate in profile, or the *stems* longer, or the *ovules* more numerous, or some combination of these features (4)
         4. Ovary and pod consistently pubescent; *ovules* 13–19; s. Rocky Mountains, Colorado, and extreme s. Wyoming, w. across the Colorado Basin to e. Nevada, s.-w. Utah, and centr. Arizona. Plastic and often variable within a colony as to stature and leaflet-length and -outline ..... 49a. var. *oblongifolius*
         4. Ovary and pod either glabrous or pubescent, but the *ovules* 6–11; n. Rocky Mountains, n.-ward from the Red Desert in Wyoming, w. to the Cascades in Washington and British Columbia, e. to the Black Hills, South Dakota (5)

5. Plants relatively tall, the fully developed stems 1.5 dm. long or more; *flower* small, the keel 6–7.8 (8.4) mm. long; *leaflets* mostly linear; Columbia Basin in Washington, n. into British Columbia, and to the Alberta Rocky Mountains. Pod either glabrous or strigulose ..... 49c. var. *serotinus*

5. Plants low, the stems less than 1.5 dm. long; *flower* nearly always larger, the keel mostly 8–10 mm. long; *leaflets,* or most of them, of a broader type, elliptic or oval; Rocky Mountains of w. Wyoming, w. Montana (and immediately adjoining Idaho) and the Black Hills. Pod nearly always glabrous ..... 49d. var. *hylophilus*

1. Pubescence of the herbage composed wholly or in great part of hairs affixed distinctly even though quite shortly above the base. Leaflets pubescent on both sides, silvery or cinereous (6)

6. Herbage strigulose with appressed or subappressed, straight or nearly straight hairs; *pod* strigulose (7)

7. Leaflets narrowly linear to linear-elliptic; *petals* (except the keel-tip) whitish or ochroleucous, sometimes brownish-veined; *ovules* 7–11; s.-w. Montana on the upper forks of the Missouri to adjoining e.-centr. Idaho and to Yellowstone Park and the Grand Tetons in n.-w. Wyoming ..... 49f. var. *praeteritus*

7. Leaflets (at least of leaves subtending the racemes) more broadly elliptic or oblanceolate; *petals* commonly pink-purple or purple-tipped, more rarely pallid; *ovules* 12–16; s. Montana on the Yellowstone River, s. (mostly e. of the Continental Divide except on the upper Green River) to centr. Wyoming ..... 49g. var. *decumbens*

6. Herbage villosulous with largely twisted and loose hairs; *pod* minutely villosulous with twisted hairs; Bitterroot Mountains, e.-centr. Idaho and adjoining Montana ..... 49h. var. *crispatus*

49a. Astragalus miser var. oblongifolius

Variable in stature, the stems (1) 2–20 (24) cm. long; *herbage* quite thinly to rather densely strigulose-pilosulous with mostly straight hairs up to 0.35–0.65 (0.75) mm. long, the leaflets green (in some colonies cinereous), the leaflets nearly always glabrous or medially glabrescent above; *leaves* (2) 4–20 cm. long, with (9) 11–19 (21) linear, linear-oblong, -elliptic, to broadly oblong or oval-elliptic, mostly acute, rarely obtuse or emarginate, flat or folded (if both folded and narrow, then subfiliform and often falcately curved) leaflets (3) 5–30 (42) mm. long, the terminal one either longer than and remote from the uppermost pair, less often contiguous to it and then either much or scarcely longer, in either case either jointed or continuous with the rachis; *racemes* 3–15 (25)-flowered, the axis (1) 1.5–10 cm. long in fruit; *calyx* (2.8) 3.4–5.2 mm. long, the tube 2.2–2.9 mm., the teeth (0.8) 1–25 mm. long; *petals* whitish, sometimes suffused with dull lilac or lilac-veined; *banner* (5.9) 6.5–9.5 (10.2) mm. long, (4.6) 5–7.8 mm. wide; *wings* 5.5–7.6 (8.2) mm. long, the claws 1.5–2.3 (3.2) mm., the blades 4–6.3 mm. long, 1.5–3.3 mm. wide; *keel* 6.1–8.4 mm. long, the claws 1.6–2.7 mm., the blades (4.2) 4.5–6.7 mm. long, (1.7) 2–2.6 (3) mm. wide; *pod* (1.2) 1.5–2.5 cm. long, oblanceolate in profile, (1.9) 2.3–4 mm. wide in the upper third, tapering downward into the calyx, the valves strigulose, sometimes dotted or suffused with purple but not mottled; *ovules* (13) 14–19.—Collections: 99 (ix); representative: *A. Nelson 198, 1276* (NY, RM); *C. L. Porter 3483* (NY, RM, TEX); *Osterhout 2774* (NY, RM); *W. A. Weber 3670* (CAS, RSA, TEX, WS); *Ripley & Barneby 7184* (CAS, NY, RSA, approximate topotypus), *7196* (CAS, RSA), *10,461* (CAS, RSA); *Hitchcock, Rethke & Van Raadshooven 4587* (CAS, WS, WTU); *E. & L. Payson 4885* (NY, WS); *A. & D. Holmgren 7818* (CAS, NY, UTC, WS); *F. J. Hermann 12,139* (NA, RSA); *Maguire 19,213, 19,991* (UTC); *Ripley & Barneby 4019* (CAS, RSA); *L. N. & L. E. Goodding 4790-Sel. 73* (ARIZ).

Dry hillsides among sagebrush, about oak thickets, ascending in open places through the timber belt where found also in shade of aspens and in humus under

pines and firs, (5500) 6000–10,300, rarely 11,300 feet, in the Rocky Mountains on granitic formations but on sedimentaries westward, frequent and locally abundant on both slopes of the Divide in Colorado, from the Sangre de Cristo Mountains and Gunnison Valley north to the upper Platte and Laramie Plains in southern Wyoming, west through the Uinta Mountains and on scattered peaks within the Colorado Basin to the plateaus of central and southwestern Utah, northwestern and central Arizona, and to the Schell Creek and White Pine Mountains in eastcentral Nevada.—Map No. 19.—Late May to August.

ASTRAGALUS MISER var. OBLONGIFOLIUS (Rydb.) Cron. in Leafl. West. Bot. 7: 18. 1953, based on *Homalobus oblongifolius* (with oblong leaflets) Rydb. in Bull. Torr. Club 34: 50. 1907. "COLORADO: Cerro Summit, 1901, *Baker 409* . . ."—Holotypus, collected by C. F. Baker, July 12, 1901, NY! isotypi, US, WS!—*A. hylophilus* var. *oblongifolius* (Rydb.) Macbr. in Contrib. Gray Herb., New Ser. 65: 37. 1922. *A. decumbens* var. *oblongifolius* (Rydb.) Cron. in Leafl. West. Bot. 3: 252. 1943.

Homalobus decurrens (decurrent, of the terminal leaflet) Rydb. in Bull. Torr. Club 31: 563. 1904.—"COLORADO: Estes Park, 1895, G. E. Osterhout . . ."—Holotypus, NY!—*Astragalus Rydbergii* (Per Axel Rydberg, 1860–1931) Macbr. in Contrib. Gray Herb., New Ser. 65: 37. 1922 (non *A. decurrens* Bss., 1851). *A. decumbens* var. *decurrens* (Rydb.) Cron. in Leafl. West. Bot. 3: 252. 1943. *A. miser* var. *decurrens* (Rydb.) Cron. in op. cit. 7: 18. 1953.

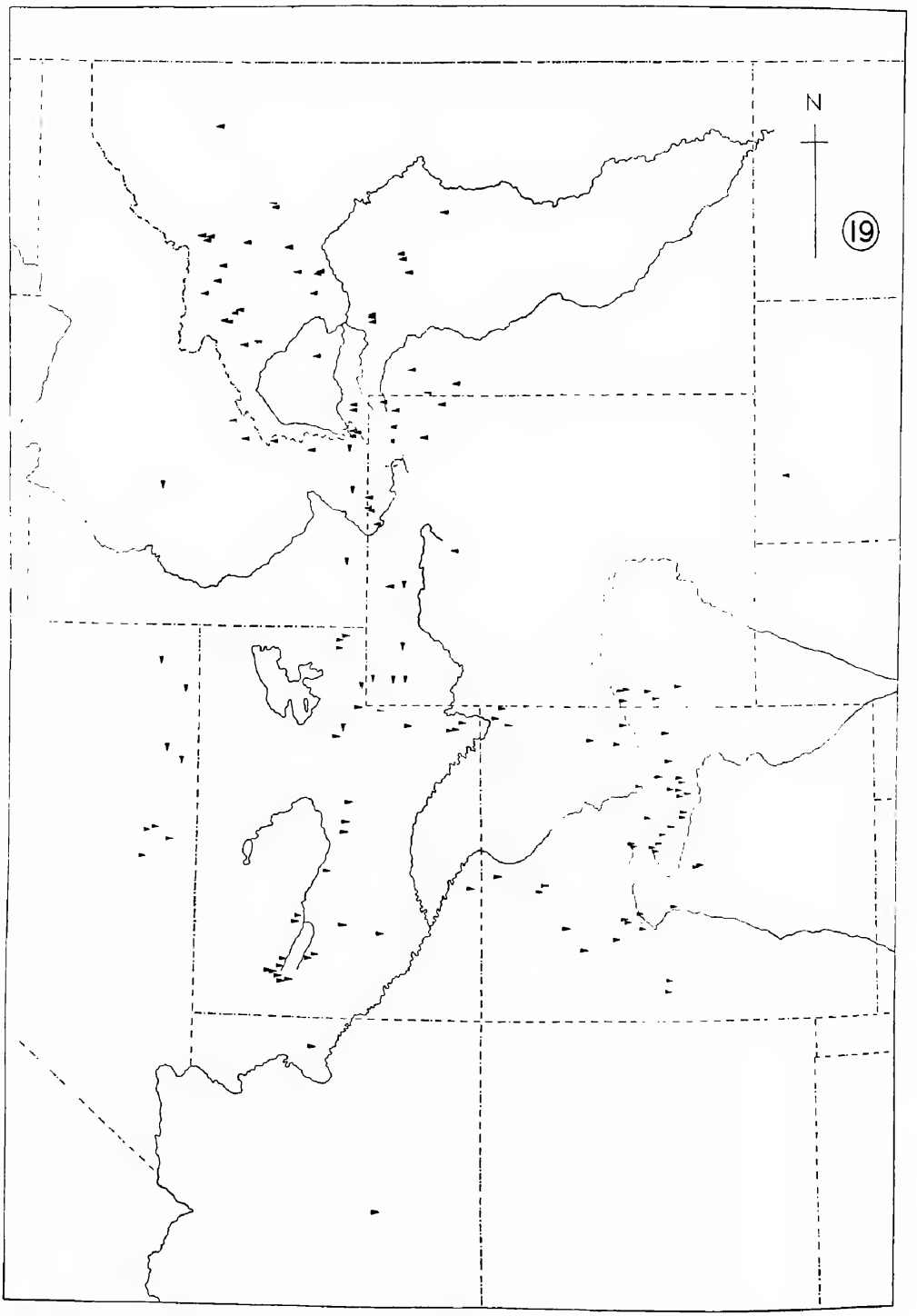
Homalobus humilis (of low growth) Rydb. in Bull. Torr. Club 34: 417. 1907.—"UTAH: Mountain north of Bullion Creek, near Marysvale, 1905, *Rydberg & Carlton 7147* . . ."—Holotypus, collected July 23, 1905, NY! isotypi, GH, US!—*Astragalus Carltonii* (E. C. Carlton) Macbr. in Contrib. Gray Herb., New Ser. 65: 36. 1922 (non *A. humilis* MB., 1808).

Homalobus microcarpus (with small pods) Rydb. in Bull. Torr. Club 34: 418. 1907.—"COLORADO: East slope of Rabbit Ear Range, 1894 (type distributed from the State Agricultural College of Colorado, collector not given); . . ."—Holotypus, NY!

Homalobus Hitchcockii (Albert Edwin Hitchcock, 1898–) Rydb. in N. Amer. Fl. 24: 271. 1929.—"Type collected at Duck Creek, Eli [= Ely], Nevada, August 17, 1913, *Hitchcock 1344* . . ."—Holotypus, with additional data "4 miles s.-e. of Paine's Ranch," US!

The var. *oblongifolius* as circumscribed above is the only representative of the weedy milkvetch known to occur in the mountains of Colorado, southeastern Wyoming, Arizona, and most of Utah, although its range slightly overlaps that of var. *tenuifolius* in the northwestern part of the latter state and possibly also in eastern Nevada. In the areas of overlap it is distinguished by its more numerous leaflets and oblanceolate rather than truly linear pod. Variation in stature, in size and shape of the leaflets, and in length of the fruits is implicit in the foregoing description of var. *oblongifolius* and has been analyzed in a revision of the species (Barneby 1956, p. 480), to which the reader should turn for details concerning most of Rydberg's segregates, here mentioned only in the synonymy. Several minor variants can often be selected out of a given population and only one of them, the so-called var. *decurrens*, is dominant in a significantly definite segment of the variety's range. My concept of var. *oblongifolius* is embodied in the collections already cited and includes var. *decurrens*. The latter is found along the east slope of Colorado's Front Range from the Cache-la-Poudre River southward to South Park and is ideally distinguished by its long, distantly disposed leaflets (up to 4 cm. long), the terminal one commonly remote from the last pair and usually continuous with the rachis (cf. *Clokey 3201*, CAS, NY). However, individual plants of this type, and many more of a transitional nature, are known to occur within heterogeneous populations of *A. miser* on both slopes of the Front Range and (more rarely) elsewhere in Colorado. It may be worth noting in this connection that duplicate sheets of one collection (*Jones 528*, from Golden, NY) were identified by Rydberg as *Homalobus decurrens* and *H. microcarpus*, respectively.

The two collections from Arizona referred to var. *oblongifolius* are scanty but unquestionably of this species. That from farthest south (junction of Young-Payson road, Gila County, *Goodding*, cited above) is very condensed, but a good match for some material from high elevations on the Wasatch Plateau in Utah. The other, from the Kaibab Plateau (V. T. Ranch, Jacob Lake Highway, Coconino County, *Goodding 244–48*, ARIZ) would run in the varietal key to var. *tenuifolius*, for the leaflets are reduced to three pairs at most. The plants are further unusual for the length and slenderness of the caudex branches, evidently partly subterranean, as though buried in mobile gravel or possibly forest litter. The pubescent ovary and ovule-number (14) are consonant with var. *oblongifolius* and the collection has been mapped as such.



Map No. 19. The Rocky Mountain States. Range (in part) of *A. miser*: ◗ var. *oblongifolius*; ◀ var. *tenuifolius*; and ◖ var. *hylophilus*.

49b. Astragalus miser var. tenuifolius

Resembling the most dwarf or condensed states of var. *oblongifolius* from dry habitats, always low and very slender, the stems 1–11 (15) cm. long; *herbage* cinereous with straight, appressed, or some narrowly ascending hairs up to 0.4–0.6 mm. long, the leaflets equally pubescent on both sides or medially glabrescent above; *leaves* (1.5) 2.5–9.5 (10.5) cm. long, with filiform rachis and (3) 7–11 narrowly linear-elliptic, or in the upper leaves often filiform-subulate, sharply acute, involute or conduplicate, mostly falcately incurved leaflets 2–10 (20) mm. long, the terminal one longer than and remote from the last pair, continuous with and tapering downward into the rachis; *racemes* (3) 6–12-flowered, the axis 1–5 (7.5) cm. long in fruit; *calyx* 2.4–3.5 mm. long, the tube 1.9–2.5 mm., the teeth 0.5–1.1 (1.4) mm. long; *petals* ochroleucous sometimes veined or suffused with dull lilac; *banner* 6–8 mm. long, 5–6.6 mm. wide; *wings* 5.3–6.6 mm. long, the claws 1.6–2.2 (2.4) mm., the blades 4.3–5.4 (6.6) mm. long, 1.7–2 mm. wide; *keel* 5.9–7 mm. long, the claws 1.6–2.1 (2.5) mm., the blades 4.4–5.2 mm. long, 1.7–2 mm. wide; *pod* almost exactly linear in profile, or if a trifle tapering downward the apex symmetrically erect, 1.2–1.6 cm. long, 2–2.7 mm. in diameter, the valves densely strigulose, sometimes mottled with brownish-purple; *ovules* 8–12 (13).—Collections: 14 (v); representative: *Hitchcock & Muhlick 10,854* (NY, WS, WTU); *J. & C. Christ 18,915* (NY, RSA); *Rollins 1622* (NY, WS); *Ripley & Barneby 9140* (RSA, UTC); *Train 3720, 3877* (NA).

Dry stony hillsides, gullied bluffs, and open mountain crests and meadows, locally plentiful at 6650–8000 feet in the drainage of the Bear, Green, and upper Snake Rivers in southwestern Wyoming and adjoining Utah and Idaho, south in Utah to the Wasatch (at ± 10,000 feet), west in scattered stations to Elko and White Pine Counties, Nevada, and apparently somewhat isolated (at 11,000 feet) on the White Cloud Range, Custer County, Idaho.—Map No. 19.—June to August.

Astragalus miser var. tenuifolius (Nutt.) Barneby in Leafl. West. Bot. 7: 195. 1954 [and again, inadvertently, in Amer. Midl. Nat. 55: 481. 1956], based on *Homalobus tenuifolius* (with fine, narrow leaflets) Nutt. ex T. & G., Fl. N. Amer. 1: 352. 1838.—"Hills of the Rocky Mountains . . . Nuttall."—Holotypus, labeled by Nuttall "*Homalobus* **tenuifolius*. R. Mts.," BM! isotypi, G, K, NY, PH!

Homalobus paucijugus (with few pairs of leaflets) Rydb. in Bull. Torr. Club 34: 418. 1907.—"Utah: Big Cottonwood Canyon . . . near the summit of the divide between Lake Solitude and Twin Lakes, 1905, *A. O. Garrett 1580*."—Holotypus, collected August 9, at 9935 ft. elevation, NY! isotypi, US, Herb. Garrett!—*Astragalus Garrettii* (Albert Osbun Garrett, 1870–) Macbr. in Contrib. Gray Herb., New Ser. 65: 36. 1922 (non *A. paucijugus* Schrenk, 1843).

Garrett's weedy milk-vetch is morphologically and geographically intermediate between var. *oblongifolius* and var. *praeteritus,* closely resembling the latter except for the basifixed pubescence, and differing from the former in its few distant leaflets and subsymmetrically linear, few-ovulate pod. The small flowers and fruits recall var. *serotinus,* a much taller plant dispersed over an area far to the north and northwest of var. *tenuifolius.* A comparatively rare, or at least seldom collected form, var. *tenuifolius* is locally common on the Bear-Green River divide in southwestern Wyoming, where it seems well adapted by reason of its reduced and attenuated foliage to the rigors of a high desert climate. The material from this area so closely matches Nuttall's type-collection as to suggest that these are his particular range of "hills of the Rocky Mountains."

49c. Astragalus miser var. serotinus

Relatively tall and slender, the stems (1) 1.5–3.5 dm. long; *herbage* strigulose with appressed or subappressed hairs up to (0.3) 0.35–0.6 (0.7) mm. long, usually thinly so, green or rarely greenish-cinereous, the leaflets glabrous above; *leaves* 4–15 (17.5) cm. long, with slender petioles and (9) 11–19 (21) usually distant, often scattered, narrowly elliptic to linear or linear-oblanceolate, acute or obtuse,

flat or (especially in some upper, rarely all leaves) involute leaflets (2) 4–30 (40) mm. long, the terminal one remote from and longer than the uppermost pair, commonly continuous with the rachis but sometimes obscurely jointed; *racemes* loosely (3) 6–16 (24)-flowered, the axis (1.5) 2.5–14 cm. long in fruit; *calyx* 3–4.2 (4.5) mm. long, the tube 2.3–3.1 (3.5) mm., the teeth 0.7–1.3 mm. long; *petals* whitish, the banner often veined or suffused and the keel tipped with pinkish-lilac, or rosy-lilac throughout; *banner* 7–9.5 (10.5) mm. long, 4.4–6.7 (7) mm. wide; *wings* 6–8.8 (9.5) mm. long, the claws 2.4–3.6 mm., the blades 4.1–6 (7) mm. long, 1.5–2.6 mm. wide; *keel* 6–7.8 (8.4) mm. long, the claws 2.6–3.6 mm., the blades 3.8–5 (5.5) mm. long, 1.8–2.2 (2.5) mm. wide, the tip narrowly triangular but scarcely beaklike; *pod* sessile or subsessile, the stipe not over 0.6 mm. long, the body linear-oblong, straight, subsymmetrically triangular at apex, 1.3–1.8 (2.1) cm. long, 2–2.8 (3.2) mm. in diameter, the valves either glabrous or minutely strigulose with hairs up to 0.2–0.35 mm. long; *ovules* 7–10 (12).—Collections: 65 (o); representative: *J. W. & E. M. Thompson 30, 86* (CAS, NY, RSA, WS, WTU); *J. M. Macoun 63,752* (CAS, NY, WS); *Hitchcock & Martin 7805* (NY, WS, WTU); *C. L. Hitchcock 17,393* (ID, NY, RSA, WS); *J. W. Thompson 7023* (CAS, WS), *10,910* (CAS, NY, WS, WTU); *Sandberg & Leiberg 473* (CAS, NY, WS).

Brushy banks, grassy flats, open hillsides, and glades in pine forest, 700–4600 (5000) feet, frequent and locally abundant in the Rocky Mountains of Alberta from Jasper Park southward just into Montana (Kootenai Mountains and south fork of Lolo River), west and south, equally or perhaps more abundantly across the mountains of southern British Columbia and south along the east slope of the Cascade Range to the Wenatchee Mountains in interior Washington.—Map No. 20.—May to August.

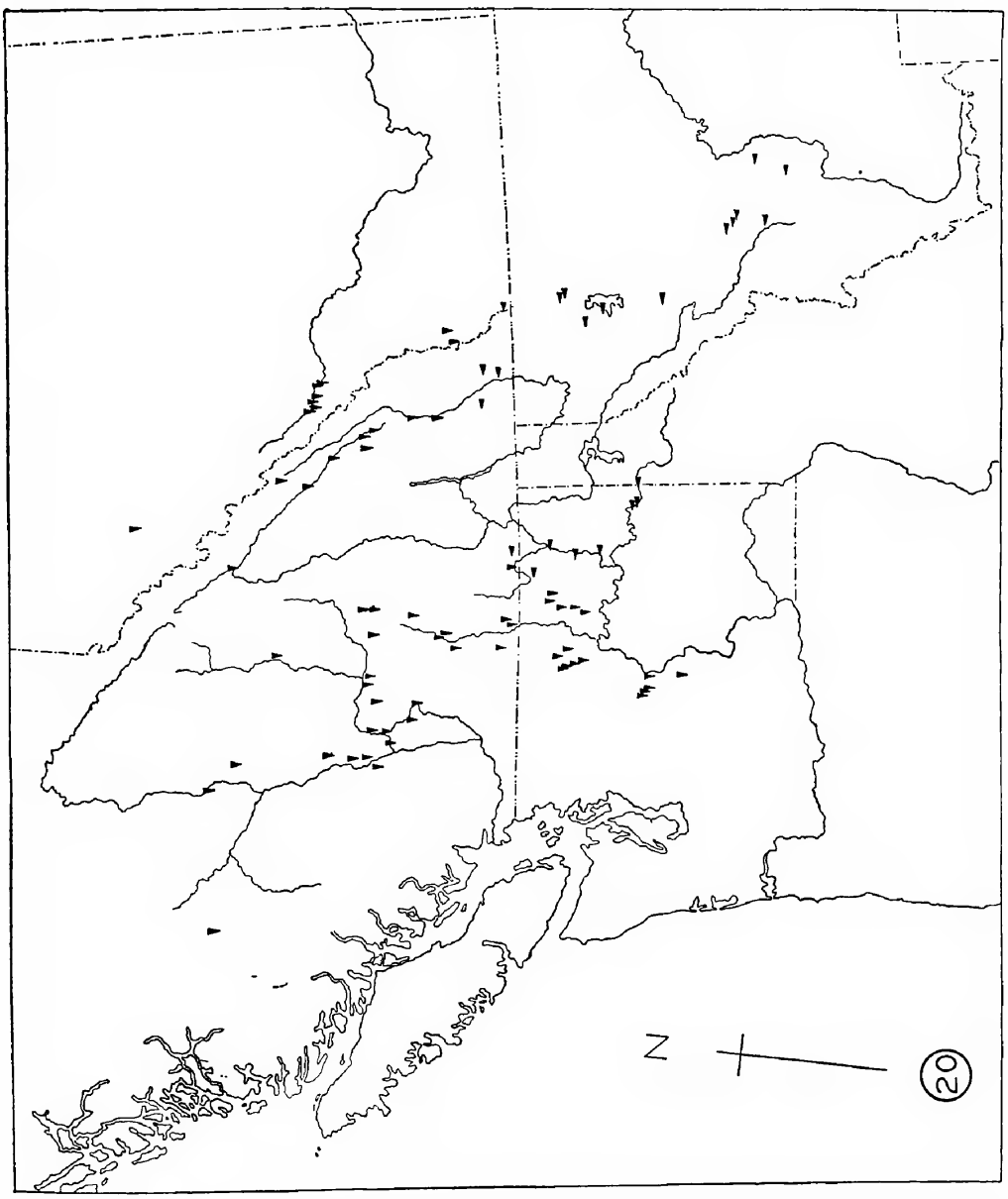
ASTRAGALUS MISER var. SEROTINUS (Gray) Barneby in Amer. Midl. Nat. 55: 481. 1956, based on *A. serotinus* (late-flowering, true of the typus only) Gray ex Cooper in Pac. R. R. Rep. 12: 51, Pl. V. 1859.—"Near the Columbia river, about latitude 48°. Rare, probably a second growth in burnt ground; October."—Holotypus, labeled "Stevens Expedition, Kooskooskie, *J. G. Cooper*," GH! isotypus, labeled "Okanogan River, Washington Territory, lat. 48°, October, 1854, *Cooper*," NY!—A Cooper spm. at US, labeled "Upper Columbia" = *A. miser* var. *miser!—Tragacantha serotina* (Gray) O. Kze., Rev. Gen. 948. 1891. *Astragalus decumbens* var. *serotinus* (Gray) Jones, Contrib. West. Bot. 10: 58. 1902. *Phaca serotina* (Gray) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 374. 1906. *Astragalus campestris* var. *serotinus* (Gray) Jones, Rev. Astrag. 75. 1923.

Astragalus Palliseri (John Palliser, b. 1817, Canadian explorer, surveyed the International Boundary from Lake Superior to the Pacific) Gray in Proc. Amer. Acad. 6: 227. 1864.—"Rocky Mountains on the British Boundary, probably not at great elevations, Bourgeau, in Palliser's expedition . . ."—Holotypus, *Phaca No. 3* in 1858, GH! isotypi, K ("Montagnes rocheuses à la base, 13 août, 1858"), NY!—*Homalobus Palliseri* (Gray) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 248. 1900.

Cooper's weedy milk-vetch, var. *serotinus*, partakes of some features of var. *hylophilus* and others of var. *miser*, and the three varieties are linked by intermediate forms where their ranges meet or overlap. It differs ideally from var. *hylophilus* in its taller stems, similarly green but narrower leaflets, smaller flowers, and ordinarily shorter calyx-teeth. The typical phase of *A. miser* is similar in stature and narrowness of the leaflets, but is distinguished by its gray or silvery foliage pubescent on both sides with longer hairs, by its larger flowers, and by the densely strigulose legume. In the Cascade Mountains of Washington and southern British Columbia, the flowers of var. *serotinus* are like those of var. *hylophilus*, pallid except for the purple keel-tip; but from the Fraser River valley eastward to the Rocky Mountains, the petals are commonly purplish and plants of this sort, especially when relatively ample-flowered, pass imperceptiby into var. *miser*. In a critical area along and near the boundary between Glacier Park and Kettle Falls on the upper Columbia, such intermediate forms are especially common, but the three varieties mentioned have, nevertheless, immense independent ranges. The variety was collected first in 1830, by David Douglas (BM, sine loc.).

49d. Astragalus miser var. hylophilus

Usually low, tufted, the stems 1–12 cm. long; *herbage* thinly strigulose-pilosulous with appressed or some narrowly ascending, straight hairs up to (0.3) 0.35–0.55 (0.6) mm. long, green, the leaflets glabrous or quite exceptionally thinly pubescent toward the margins above; *leaves* (3) 4.5–19 cm. long, with (9) 11–21 ("25") narrowly elliptic to lanceolate, lance-oblong, or broadly oval (the extremes often on the same plant), acute, obtuse and mucronulate, obtuse, or rarely retuse, flat, thin-textured leaflets (3) 5–26 mm. long, the terminal one either contiguous to or remote from the last pair, commonly jointed to the rachis, the joint sometimes obscure, rarely obsolete; *racemes* (3) 6–16-flowered, the axis (1)



Map No. 20. Parts of northwestern United States and southwestern Canada. Range (in part) of *A. miser*: ◆ var. *serotinus*; and ◖ var. *miser*.

1.5–7 cm. long in fruit; *calyx* (3.8) 4–5.6 mm. long, the tube 2.6–3.5 mm., the teeth (0.9) 1–2.3 mm. long; petals whitish, the banner sometimes lavender-veined, the keel-tip maculate; *banner* (5.2) 6.5–13 mm. long, (5.7) 6.2–9.2 wide; *wings* (6.6) 7.2–9.5 mm. long, the claws (2.3) 2.5–3.4 mm., the blades (4.6) 5.3–6.9 mm. long, (1.9) 2.2–3 mm. wide; *keel* (7.1) 8–10 (11.4) mm. long, the claws 2.4–3.5 mm., the blades (4.9) 5.4–7 (8.5) mm. long, 2.2–3 mm. wide; *pod* (1.5) 1.8–2.5 cm. long, 2.5–4 mm. in diameter, exactly linear, linear-elliptic, or commonly by a trifle widest above the middle and thus linear-oblanceolate in profile, the apex erect or not greatly oblique, the whole straight or a little arched either way, the valves glabrous or exceptionally puberulent with a few scattered, usually black hairs; *ovules* (6) 7–11.—Collections: 94 (ii); representative: *Hitchcock & Muhlick 11,742, 12,436, 12,743* (CAS, NY, RSA, WS); *C. L. Hitchcock 16,522* (NY, RSA, WS); *Jean Witt 1255* (CAS, NY, SMU, WS); *F. J. Hermann 12,300, 12,315* (NA, RSA); *A. & E. Nelson 6627* (ND, NY, RM); *C. L. Porter 5426* (CAS, NY, RM, TEX).

Mountain meadows, grassy banks, open parklands, and forested slopes, with lodgepole pine or Douglas fir, sometimes in yellow pine forest, rarely on cliff ledges, open rocky crests, or in moist soil along mountain brooks, mostly within the timber belt but coming out onto dry hillsides with sagebrush, or onto road cuts, with no apparent rock-preference, 3200–9500 feet, common and locally abundant in the Rocky Mountains of western Montana, from Lewis and Clark and Lake Counties south to the Wind River and Grand Teton ranges in western Wyoming, extending feebly west into eastern Idaho; apparently isolated on the Black Hills, South Dakota.—Map No. 19.—June to August.

ASTRAGALUS MISER var. HYLOPHILUS (Rydb.) Barneby in Amer. Midl. Nat. **55**: 482. 1956, based on *Homalobus hylophilus* (partial to woods) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 248. 1900.—"MONTANA: Bridger Mountains, July [June] 17, 1897, *P. A. Rydberg & Ernst A. Bessey 4490* . . ."—Holotypus, NY! isotypi, GH, K, ND, PH, US!—*Astragalus hylophilus* (Rydb.) A. Nels. in Coult. & Nels., New Man. 291. 1909. *A. campestris* var. *hylophilus* (Rydb.) Jones, Rev. Astrag. 75. 1923. *A. convallarius* var. *hylophilus* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. **50**: 20. 1937.

In the mountains of western Montana southward approximately from the latitude of Great Falls to the headwaters of the Green and Snake Rivers in western Wyoming, the var. *hylophilus* is one of the commonest astragali. As the epithet implies, it is characteristic of the timber belt, being replaced in the intervening valleys and (largely) in arid microhabitats within the timber zone by other varieties of the species, all distinguished by gray- or silvery-strigulose herbage and pubescent fruits. Of these sympatric but ecologically separated forms, var. *praeteritus* and var. *decumbens* differ further in the attachment of the hairs, whereas var. *miser,* with basifixed vesture, is commonly a taller plant with purple or purplish flowers. In most cases var. *hylophilus* is recognized at sight by its green leaflets of broad outline and thin texture, and by its whitish flowers of moderate or (for the species) large size. In dry situations and at low elevations, however, the leaflets of some or even all leaves may become narrow and firm; plants of this sort simulate phases of the more southern vicariant var. *oblongifolius,* although they still differ in the glabrous few-ovulate pod. There are a few examples on record, from the Grand Tetons and the Yellowstone Park region, of var. *hylophilus* with thinly black- or white-strigulose pod (e.g., *E. & L. Payson 2068,* CAS, NY), but these minor variants, which suggest another type of transition into var. *oblongifolius,* have the characteristic ample foliage and few ovules of their sort. In extreme northwest Montana, var. *hylophilus* apparently passes into the very closely related but ordinarily taller and smaller-flowered var. *serotinus.* The plant from the Black Hills is the common Cordilleran type.

49e. ASTRAGALUS MISER var. MISER

Rather tall, often stiffer and more wiry than other forms of *A. miser,* the stems diffuse, ascending, or erect, (5) 8–32 cm. long; *herbage* densely (rarely more thinly) strigulose-pilosulous with appressed and ascending, or nearly all loosely ascending hairs up to 0.5–0.9 (1) mm. long, cinereous or canescent, the

leaflets pubescent on both sides but sometimes thinly so near the midrib above; *leaves* 4–14 (17) cm. long, with 9–19 linear-elliptic to narrowly linear, or (in some lower leaves) narrowly elliptic, acute, commonly folded and falcately incurved leaflets 3–26 (30) mm. long, the terminal one nearly always longer than and remote from the last pair and continuous with the rachis, the joint sometimes represented by an obscure strangulation, rarely with a distinct petiolule; *racemes* very loosely and often remotely (5) 7–19-flowered, the axis early elongating, (2) 4–12 cm. long in fruit; *calyx* (4.2) 4.6–6 mm. long, the tube 2.6–4.2 mm., the teeth (1.4) 1.8–2.6 mm. long; *petals* all pink-purple or lavender, the color sometimes fugitive in drying, sometimes straw-yellow in old specimens; *banner* (9.5) 9.8–12 mm. long, 6–8.6 mm. wide; *wings* 8.1–10.6 mm. long, the claws 3.1–4.3 (4.7) mm., the blades (5.3) 5.6–7.5 mm. long, 2–2.9 mm. wide; *keel* (8) 8.6–10.7 mm. long, the claws 3.2–4.8 mm., the blades (4.8) 5.5–6.7 mm. long, (2) 2.3–3 mm. wide; *pod* linear-oblong or -elliptic in profile, 1.5–2.2 (2.5) cm. long, (2.5) 3–4 mm. in diameter, contracted distally into a subsymmetrically triangular apex, the valves often purple-speckled, densely strigulose with hairs up to 0.35–0.6 mm. long; *ovules* 8–12 (17).—Collections: 25 (iii); representative: *Constance 1902* (WS, WTU); *Geyer 475* (GH); *Christ 10,250* (ID, NY); *H. T. Rogers 652* (CAS, NY, SMU, WIS, WS, WTU); *C. L. Hitchcock 17,839* (CAS, ID, NY, RSA); *Hitchcock & Muhlick 11,684* (CAS, NY, RSA, WS); *Ripley & Barneby 10,953* (CAS, NY, RSA).

Dry grassy hilltops, sagebrush flats, open stony meadows, sometimes in open yellow pine forest, 1300–4550 feet, locally plentiful around Flathead Lake and along the lower Kootenai River in northwestern Montana, south to Deer Lodge Valley in Powell County, and east just across the Divide to the Missouri Valley in Jefferson and Lewis and Clark Counties and to Waterton Park, Alberta, west to the upper Columbia and Spokane Rivers in Ferry, Stevens, and Spokane Counties, Washington, and immediately adjoining British Columbia.—Map No. 20.—Late April to early August.

ASTRAGALUS MISER (wretched, of the type-specimen) Dougl. ex Hook., Fl. Bor.-Amer. 1: 153, in nota. 1831.—"On low hills of the Spokan River, sixty miles from its confluence with the Columbia."—Holotypus, from "Sandy banks of the Spokan River, 1826.", BM! isotypus, OXF! phototypus, NY!—*Tragacantha misera* (Dougl.) O. Kze., Rev. Gen. 946. 1891. *Phaca misera* (Dougl.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 373. 1906, quoad nom. *Tium miserum* (Dougl.) Rydb. in N. Amer. Fl. 24: 394. 1929, quoad nom.

Astragalus strigosus (appressed-hairy, or perhaps in the classical sense, lean and lanky) Coult. & Fish. in Bot. Gaz. 18: 299. 1893.—"Basin, Montana, July, 1892, F. D. Kelsey."—Holotypus, not located; isotypus (fragm.), dated July 1, 1892, US!—*A. griseopubescens* (gray-hairy) Sheld. in Minn. Bot. Stud. 1: 24. 1894, a superfluous substitute, the supposed obstacle being merely Sheldon's own *A. strigosus* (Kell.), 1894. *Homalobus strigosus* (Coult. & Fish.) Rydb. in Bull. Torr. Club 40: 53. 1913. *Astragalus serotinus* var. *strigosus* (Coult. & Fish.) Macbr. in Contrib. Gray Herb., New Ser. 65: 37. 1922.

As I have seen it flowering in the Kootenai and Deer Lodge Valleys in western Montana, the typical form of the weedy milk-vetch is a comparatively showy and even decorative plant. It is similar in stature and general growth-habit to the more northern and western var. *serotinus*, but differs in the more copious ashen vesture of longer hairs and in the substantially larger flowers of a moderately bright purple hue. One should take care to distinguish var. *miser* from the less common but superficially similar tall lowland form of *A. Bourgovii*; this may be recognized by its nearly always black-hairy pod and remarkably few (2–6) ovules.

The name *A. miser* has been applied to the present species only since 1953, when Cronquist examined the typus in London and found it to represent, as was already expected from a photograph, a form of what had passed in recent years as *A. decumbens* (Nutt.) Gray (=our *A. miser* var. *decumbens*). The name has been current in the literature since early times, having been taken up by Gray (1864, p. 228), who believed that no Douglas specimens had survived, in the sense of *A. microcystis (Lyall 7)*. Gray's interpretation was accepted by Piper (l.c. sub *Phaca*) and by Jones (1923, p. 98), but was rejected by Rydberg, who professed to have dis-

covered the genuine species of Douglas in a form of *A. obscurus* (l.c., sub. *Tio;* 1931, pp. 403–4, discussion). Dr. Cronquist tells me that it was Prof. Marion Ownbey who first realized that *Tium miserum* of Rydberg's Revision was not known from modern collections to occur in eastern Washington, and it was he who initiated a re-evaluation of the typus. My adoption of the name in a sense somewhat more restricted than that of Cronquist's revision of the species has been discussed elsewhere (1956, p. 482); it may be worth repeating, nevertheless, that for the purposes of fixing the precise identity of the original *A. miser,* I have considered an approximate topotypus, *Constance 1902* (cited above), from the mouth of the Little Spokane River in Spokane County, as a standard of comparison.

49f. Astragalus miser var. praeteritus

Usually dwarf and tufted, the stems (1.5) 2.5–20 cm. long; *herbage* silvery-cinereous throughout with straight or nearly straight, appressed and some few ascending hairs up to 0.4–0.7 (0.8) mm. long, the leaflets nearly always equally pubescent on both sides; leaves (1.5) 2.5–9.5 cm. long, with 7–13 (15) linear-elliptic, very acute, mostly folded or involute, often falcately incurved leaflets 2–20 mm. long, the terminal one of all or of nearly all leaves longer than and remote from the last pair, tapering into and continuous with the rachis; *racemes* loosely (3) 5–12-flowered, the axis (1) 1.5–7.5 cm. long in fruit; *calyx* (2.3) 2.8–3.9 mm. long, the tube (1.7) 2.2–2.9 mm., the teeth 0.6–1.4 mm. long; *petals* whitish or straw-color, sometimes veined with brownish-lilac; *banner* 6.6–8.6 (10) mm. long, (4.5) 5–7.4 mm. wide; *wings* 5.5–7.8 (8.1) mm. long, the claws 1.6–2.5 (2.9) mm., the blades 4.2–5.7 (6) mm. long, (1.3) 1.6–2.5 mm. wide; *keel* 6.2–8.3 (8.8) mm. long, the claws 1.7–2.6 (3) mm., the blades (4.4) 4.6–6 mm. long, 1.9–2.3 mm. wide; *pod* exactly linear, or a trifle dilated upward and linear-oblanceolate, or (when short) linear-elliptic in profile, straight or nearly so, 1.1–2 cm. long (2) 2.5–3.4 mm. in diameter, subsymmetric at apex, the valves densely strigulose, commonly mottled with brownish-purple; *ovules* 7–11.—Collections: 42 (i); representative: *Lingenfelter 548* (CAS, NY, RSA, SMU, WS); *Hitchcock & Muhlick 12,532, 14,131, 14,160* (CAS, NY, RSA, WS); *C. L. Hitchcock 15,825* (NY, RSA, WS); *A. & R. Nelson 5649* (NY); *Tweedy 259* (NY).

Dry banks, hillsides, and gravelly knolls, commonly among sagebrush, but ascending to grassy and stony slopes in open lodgepole pine forest, 5200–8000 feet, locally plentiful on the forks of the Missouri in southwestern Montana, from the valley of the Madison River westward and southward across the Divide to the upper Lemhi, Salmon and Lost Rivers in eastcentral Idaho, south through Yellowstone Park to the Grand Tetons and Hoback River in northwestern Wyoming.—Map No. 21.—May to August.

Astragalus miser var. praeteritus (overlooked) Barneby in Amer. Midl. Nat. 55: 483. 1956.—"Montana. Along Ruby River, 2 miles south of Vigilante Experiment Station, Madison Co., 28 July, 1947, *C. L. Hitchcock No. 16944* . . ."—Holotypus, WS! isotypi, NY, RSA!

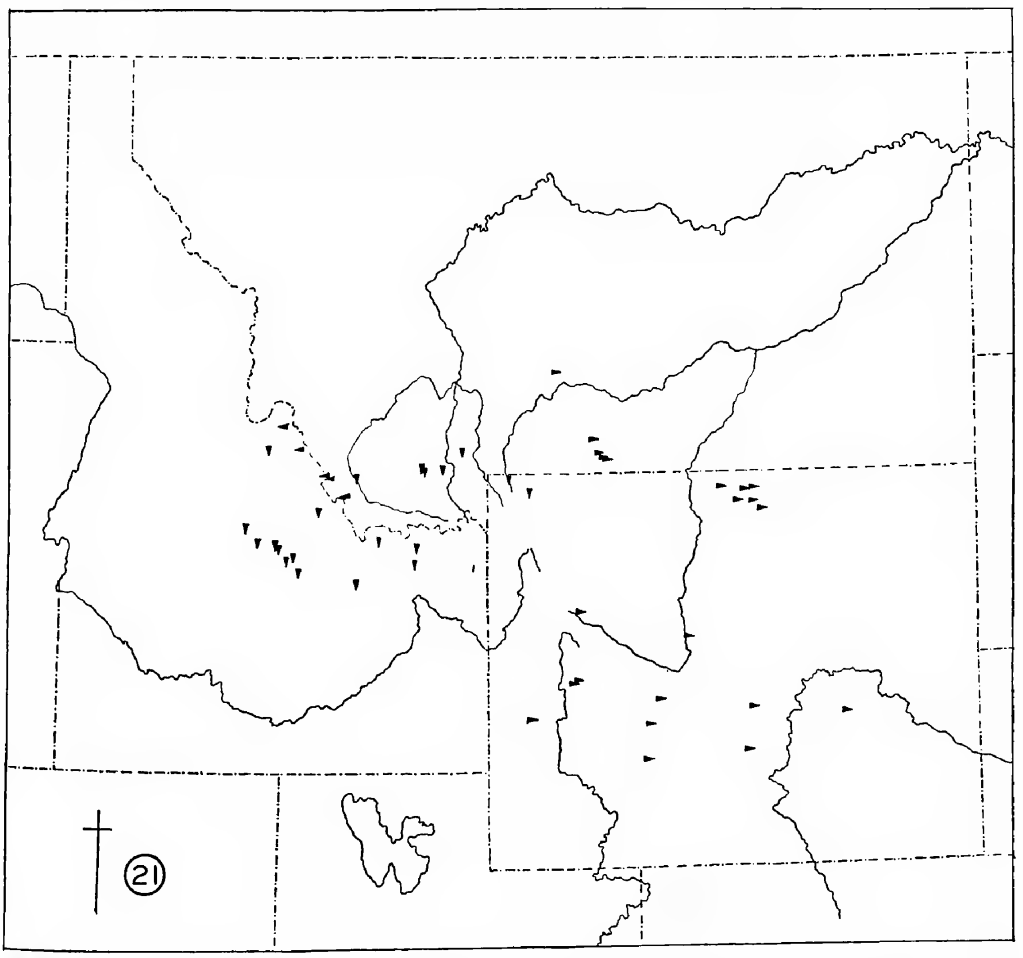
With var. *praeteritus* I begin to describe the three forms of the weedy milk-vetch set off collectively from the rest by a suprabasal hair-attachment. They are closely interrelated, all low tufted plants with gray or silvery foliage, difficult to distinguish without somewhat minute observation. Of the three the var. *praeteritus* is apparently the least specialized, often being separable from var. *tenuifolius* by the form of the hairs alone; and the dolabriform hairs themselves are sometimes few and scattered and, moreover, affixed close to the lower end, so that in effect there is in this variety a gradual transition from one type of vesture to the other. Populations of var. *praeteritus* with only few dolabriform hairs are particularly common on the headwaters of the Snake River and in the foothills of the Tetons, precisely where its range abuts on that of var. *tenuifolius.*

49g. Astragalus miser var. decumbens

Commonly dwarf and densely tufted, the stems 1–15 (22) cm. long; *herbage* silvery-silky with appressed and often some longer, ascending, straight or nearly

straight hairs up to (0.5) 0.6–1 mm. long, the leaflets equally pubescent on both sides; *leaves* 1.5–9 (12) cm. long, with (7) 9–15 (17) narrowly elliptic to oval-oblanceolate, mostly acute but sometimes obtuse, flat or folded leaflets (2) 4–16 (20) mm. long, the terminal one either contiguous to or remote from, but scarcely longer than the last pair, either decurrent or jointed; *racemes* (4) 7–14-flowered, the axis little elongating, 1–3 (4) cm. long in fruit; *calyx* 2.8–4.3 mm. long, the tube 1.8–2.5 mm., the teeth 0.9–1.9 mm., long; *petals* commonly all purplish, bluish, or tipped with dull purple, sometimes whitish except for the maculate keel-tip; *banner* 6.9–9.6 mm. long, 5.2–7.4 mm. wide; wings 5.4–7.1 mm. long, the claws 1.5–2.5 mm., the blades 4–5.2 mm. long, (1.4) 1.7–2.5 mm. wide; *keel* 6.2–7.8 mm. long, the claws 1.5–2.6 mm., the blades 4.9–6 mm. long, 1.8–2.3 mm. wide; *pod* linear-oblong or -oblanceolate in profile, usually widest a little below the apex but the tip not strongly oblique, straight or obscurely sigmoid, (1.2) 1.4–2.1 cm. long, 2.2–3.3 mm. in diameter, the densely strigulose valves faintly mottled; *ovules* 12–18.—Collections: 31 (vi); representative: *C. L. Hitchcock 16,558, 16,626* (NY, RSA, WS); *Ripley & Barneby 7945* (CAS, RSA, UTC); *L. & R. Williams 3145* (NY, WS, WTU); *C. L. Porter 5372* (NY, RM); *Merrill & Wilcox 537, 585* (NY).

Dry gravelly clay banks, hillsides, bluffs, and gullied knolls, commonly among



Map No. 21. Idaho, Montana, and Wyoming. Range (in part) of *A. miser*: ◗ var. *decumbens*; ◀ var. *praeteritus*; and ◖ var. *crispatus*.

sagebrush at 3700–7600 feet, ascending in the Big Horn Mountains on stony meadows up to 9600 feet, without apparent rock preference although most abundant on sedimentary formations, locally plentiful in the foothills of western Wyoming, from the upper Green River Valley and the west affluents of the North Platte, north through the Wind, Big Horn, and Powder Valleys to the upper Yellowstone River in southcentral Montana.—Map No. 21.—Mid-May to August.

ASTRAGALUS MISER var. DECUMBENS (Nutt.) Cron. in Leafl. West. Bot. 7: 18. 1953, based on *Homalobus decumbens* (reclining) Nutt. ex T. & G., Fl. N. Amer. 1: 352. 1838.—"Sandy plains of the Colorado of the West, near the sources of the Platte . . . *Nuttall.*"—Holotypus, labeled by Nuttall "*Homalobus *decumbens.* R. Mts. Platte," BM! isotypi, GH, K, NY, PH! —*Astragalus decumbens* (Nutt.) Gray in Proc. Amer. Acad. 6: 229. 1864. *Tragacantha decumbens* (Nutt.) O. Kze., Rev. Gen. 944. 1891. *Phaca decumbens* (Nutt.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 373. 1906. *Astragalus campestris* var. *decumbens* (Nutt.) Jones, Rev. Astrag. 74. 1923. *A. decumbens* var. *decumbens* Cron. in Leafl. West. Bot. 3: 251. 1943, pro parte.

Phaca parvifolia (small-leaved) Nutt. ex T. & G., Fl. N. Amer. 1: 348. 1838.—"Rocky Mountains towards the sources of the Platte."—Holotypus, labeled by Nuttall "*Phaca *parvifolia.* R. Mts.," BM!—The spm. at PH, labeled by Nuttall "*Astragalus *parvifolius.* Missouri." = *A. gracilis* Nutt., q. v.

Astragalus divergens (bending outward) Blank. in Mont. Agr. Coll. Sci. Stud. 1: 73, Pl. II, 1905 (feb.).—" . . . near Big Coulee creek, about 30 miles northeast of Big Timber, Sweet Grass county, June 15, 1902."—No typus examined, but the description, excellent accompanying illustration, and Rydberg's identification of *H. camporum* with it, are decisive.—*Homalobus divergens* (Blank.) Rydb. in Bull. Torr. Club 34: 417. 1907.

Homalobus camporum (of the plains) Rydb. in Bull. Torr. Club 32: 666. 1905 (dec.).—"WYOMING: Bush Ranch, Sweetwater Co., June 10, 1900, *Aven Nelson 7085.*"—Holotypus, from "summit of Steamboat Mountain," NY!

On account of its ordinarily pink-purple flowers, var. *decumbens* is the most handsome of the malpighian-haired forms of weedy milk-vetch. It is locally abundant in western Wyoming, sometimes found in such numbers as to lay down a roseate carpet of blossoms over stony gaps between clumps of sagebrush, lupine, and *Wyethia.* There are, however, whole populations, especially prevalent in the Big Horn Valley, in which only the keel-tip is stained with color, the other petals being whitish or almost pure white turning straw-color on drying. Such plants closely resemble var. *praeteritus,* differing only in having leaflets on the average (and for the most part absolutely) broader and in the higher ovule-number.

49h. ASTRAGALUS MISER var. CRISPATUS

Closely resembling the two preceding, usually low, the stems 2.5–15 cm. long; *herbage* densely gray- or silvery-villous and -pilosulous with mostly sinuous and loosely ascending (together with some subappressed) hairs up to 0.9–1.25 mm. long, the leaflets equally pubescent on both sides; *leaves* 1.5–8.5 cm. long, with (9) 11–17 narrowly elliptic or oblong-elliptic, acute or shortly acuminate leaflets 3–16 mm. long, the terminal one commonly subcontiguous with the last pair, either obscurely jointed or confluent with the rachis; *racemes* 9–17-flowered, rather dense in early anthesis, the axis 2–5.5 cm. long in fruit; *calyx* 3.7–4.7 mm. long, the tube 2.4–2.8 mm., the teeth 1.1–2.4 mm. long; *petals* whitish or ochroleucous, sometimes faintly lavender-tinged or -veined; *banner* 9.2–10.4 mm. long, 6.4–8.8 mm. wide; *wings* 7.7–8 mm. long, the claws 2.5–3.1 mm., the blades 5.1–6 mm. long, 1.9–2.6 mm. wide; *keel* 7.7–8.3 mm. long, the claws 2.6–3 mm., the blades 5.3–5.8 long, 2.3–2.6 mm. wide; *pod* linear-oblong in profile, straight or nearly so, symmetric at apex, 1.4–1.7 cm. long, 2.5–3 mm. in diameter, the valves minutely strigulose-villosulous with twisted hairs, faintly mottled; *ovules* 6–13.—Collections: 9 (i); representative: *Christ & Ward 14,778* (ID, NY, RSA); *C. L. Hitchcock 15,774* (NY, RSA, WS); *E. & L. Payson 1762* (CAS, NY); *Ripley & Barneby 8863* (CAS, NY, RSA).

Open pine woods, brushy canyon banks, and sagebrush flats, locally plentiful

on both slopes of the Bitterroot Mountains in Lemhi County, Idaho, and Beaverhead County, Montana.—Map No. 21.—June to August.

ASTRAGALUS MISER var. CRISPATUS (Jones) Cron. in Leafl. West. Bot. 7: 18. 1953, based on *A. campestris* var. *crispatus* (curled, of the vesture) Jones, Rev. Astrag. 75, Pl. 2. 1923.—"Alta, Montana, in pinewoods."—Holotypus, collected by Jones at 5000 ft., July 23, 1909, POM!—*A. decumbens* var. *crispatus* (Jones) Cron. & Barneby in Leafl. West. Bot. 5: 34. 1947.

Because of its comparatively broad leaflets, var. *crispatus* is suggestive at first sight of var. *decumbens* rather than var. *praeteritus,* although it resembles the latter in its pale flowers and few ovules. The curly and usually long hairs of the herbage and the minutely crisped vesture of the pod are quite distinctive; there are, however, examples from the Bitterroots (cf. *Christ 14,799,* NY) of a type of pubescence transitional to that of var. *praeteritus.* The known range of the variety extends along the Bitterroot Range from near North Fork southeast to Bannock Pass, a distance of about sixty miles.

50. ASTRAGALUS CONVALLARIUS

Commonly slender, wiry, sparsely leafy or apparently almost leafless and rushlike, with a taproot and subterranean root-crown, densely to quite thinly strigulose with straight, appressed or narrowly ascending, filiform or somewhat flattened hairs up to 0.3–0.6 (0.7) mm. long, the stems and herbage greenish-cinereous, cinereous, or sometimes canescent, the leaflets (when present) either equally pubescent on both sides or glabrescent to quite glabrous above; *stems* usually few, commonly ± 4–6, sometimes solitary, rarely up to 37, erect, ascending, or exceptionally diffuse or prostrate, (1) 1.5–8 dm. long, subterranean for a space of 1–7 cm., simple, leafless, commonly purplish at base, thereafter (sometimes at the first emersed node, usually beyond it) bearing divaricate-ascending or rather strict branches or spurs at 1–6 nodes preceding the first peduncle, the branches sometimes again branched, those of the primary axis often paired with a smaller branch, a spur, or a peduncle, or the peduncles paired distally, the whole becoming flexuous or zigzag distally, striate throughout; *stipules* ± dimorphic, those at the buried and lower emersed nodes papery-scarious, pallid or purplish-brown, often several-nerved, (1) 2–7 mm. long, amplexicaul and connate into a campanulate sheath, the median and upper ones nearly always smaller, herbaceous, ovate, triangular, or deltoid, commonly only semiamplexicaul, rarely briefly united at base; *leaves* 2–11 cm. long, the leaflets of the upper leaves, sometimes of all, greatly reduced, wanting, or decurrent on the rachis, when present up to 6 pairs, then distant, linear, linear-oblong, or -oblanceolate, involute or rarely flat, up to 25 (33) mm. long, mostly much shorter; *peduncles* erect, incurved-ascending, or divaricate, (1) 3–14 cm. long, either longer or shorter than the leaf; *racemes* very loosely or remotely (1) 3–25-flowered, the flowers early spreading, at length declined and often irregularly secund, the axis (0.5) 2–18 (23) cm. long in fruit; *bracts* thinly herbaceous becoming papery, ovate or lanceolate, 0.5–2.3 mm. long, greenish, pallid, or purple-tinged; *pedicels* slender or subfiliform, at anthesis ascending at a wide angle or arched outward, 1–4.5 mm. long, in fruit straight and ascending, straight and divaricate, geniculate at base and refracted, or tortuous, 2–8 mm. long, tardily disjointing with the fruit; *bracteoles* 0–2, minute when present; *calyx* 4–6.3 mm. long, strigulose with black, white, or mixed hairs, the symmetric or slightly oblique disc 0.6–1 (1.4) mm. deep, the campanulate tube 3.4–5.4 mm. long, rounded or obliquely turbinate at base, sometimes a trifle constricted at the mouth and then obscurely urceolate, the broadly subulate, triangular, or deltoid, mostly obtuse teeth 0.5–1.4 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, ochroleucous veined or tinged with dull purple, sometimes bright rose-purple, all strongly incurved through at least a right angle, usually not strongly graduated, the wings (detached) often a trifle longer than the banner but arched in

a longer and wider arc and so, in situ, appearing shorter; *banner* (6.6) 7–11.2 mm. long, the shortly cuneate claw abruptly expanded into a broadly ovate, rhombic-ovate, suborbicular, or inversely reniform, shallowly and openly notched or entire blade 5–8.2 mm. wide; *wings* (7) 7.7–12.6 mm. long, the claws (3) 3.5–5.6 mm., the lunately oblong, oblong-oblanceolate, or obliquely obovate, obtuse, often erose, or sometimes subemarginate blades 3.5–7 mm. long, (1.6) 2–3 mm. wide, their inner margins commonly infolded and once or more undulately notched near the middle; *keel* (6.2) 6.5–9.4 mm. long, the claws (3) 3.2–5.4 mm., the lunately triangular, or lunately half-circular blades 3.5–6.1 mm. long, 2.2–3.6 mm. wide, abruptly incurved through 100–125° to the triangular or sometimes triangular-acuminate, subacute or obtuse, often obscurely porrect apex; *anthers* 0.55–0.75 mm. long; *pod* essentially pendulous, but spreading vertically from divaricate peduncles and then (in pressed material) apparently horizontal, sessile but sometimes basally attenuate and then appearing very shortly and obscurely stipitate, the body linear, linear-oblong, linear-acuminate, or sometimes attenuate downward from near the apex and then oblanceolate in profile, straight or a trifle arched either way, 1.3–5 cm. long, 2.3–4 mm. in diameter, laterally compressed, bicarinate by the slender sutures, the faces flat when young becoming distended and low-convex at maturity, the thin, pale green, purplish, or purple-mottled, strigulose valves becoming papery, stramineous, delicately cross-reticulate, not inflexed; *dehiscence* apical and downward through both sutures, the valves ultimately separating to the base and coiling outward; *ovules* (11) 13–26; *seeds* brown or olivaceous, sometimes purple-speckled, smooth and lustrous, or ± pitted or rugulose and then either dull or shining, 1.8–4.3 mm. long.

The lesser rushy milk-vetch, *A. convallarius,* is a variable species but usually recognized at a glance by its sparsely leafy or apparently leafless stems arising from a buried root-crown and genuinely leafless at base, and especially by its small, loosely racemose flowers with petals little graduated and all very strong incurved. Apart from its mesophytic counterpart, *A. diversifolius,* of which the differential characters have been mentioned in the sectional key, only a few *Lonchocarpi,* especially the members of subsect. *Pseudogenistoidei,* resemble *A. convallarius* in all these features. They differ in having all the stipules free, the lowest ones moreover larger (not smaller) than the succeeding ones and several- or many-nerved. The *Pseudogenistoidei* are rare species, endemic to Arizona, outside the known range of *A. convallarius.*

Key to the Varieties of A. convallarius

1. Pod exactly linear, linear-oblong or -lanceolate in profile, gradually or abruptly contracted into the nearly symmetric apex; *petals* never bright purple, commonly ochroleucous, rarely veined or suffused with brownish- or livid purple; widespread, but extending e. in Colorado no farther than Moffat County (2)
   2. Pod elongate, linear or linear-lanceolate, 2.5–5 cm. long, 2.5–3.3 mm. in diameter, 8–18 times longer than wide; widespread, but not in extreme s.-w. Utah and adjoining Nevada ..... 50a. var. *convallarius*
   2. Pod shorter and relatively broader, 1.3–2.4 cm. long, 3.4–4 mm. in diameter, 4–6 times longer than wide; extreme s.-w. Utah and adjoining Nevada ..... 50b. var. *finitimus*
1. Pod narrowly oblanceolate in profile, tapering downward into the calyx from the obliquely triangular apex; *petals* often rose-purple, sometimes ochroleucous tinged with purple; w. slope of the Colorado Rocky Mountains, mostly within the valleys of the Grand and Gunnison Rivers ..... 50c. var. *scopulorum*

50a. Astragalus convallarius var. convallarius

Stems (1) 2–5 (7) dm. long; *hairs* of the herbage (0.35) 0.4–0.6 (0.7) mm. long, the leaflets sometimes glabrous above; *leaflets,* when present, 1–5 pairs, linear, linear-filiform, or elliptic, commonly involute, exceptionally expanded and up to 3 mm. wide, 2–25 (33) mm. long; *pedicels* at anthesis 1–3.5 mm., in fruit 2.2–5 mm. long; *bracteoles* 0; *calyx* 4.2–6 mm. long, either black- or white-strigu-

lose, the tube 3.4–4.8 mm. long, (2.2) 2.5–3 mm. in diameter, the teeth 0.5–1.4 mm. long; *banner* 8–11 mm. long; *wings* 8.5–10.5 mm. long; *keel* 8.1–9.4 mm. long, the blades 4.8–6.1 mm. long, 2.3–3 mm. wide; *pod* straight or nearly so; *ovules* 13–20; *seeds* 2.5–4.3 mm. long—Collections: 76 (xi); representative: *Hitchcock & Muhlick 11,781* (NY, RSA, WS); *Macbride & Payson 2993* (CAS, NY); *J. & C. Christ 18,584* (NY, RSA); *C. L. Porter 3602, 5068* (NY, RM, SMU, TEX); *Maguire 13,717* (CAS, WS, WTU); *L. Williams 453* (CAS, NY); *W. A. Weber 5347* (CAS, SMU, TEX); *Ripley & Barneby 8638* (CAS, RSA).

Hillsides, bluffs, benches and valley floors, in dry sandy, loamy, or clay soils of various origin and composition, without apparent rock preference, but most abundant on sedimentary formations, characteristically associated with sagebrush, 4150–7800 ("9000") feet, common and locally abundant in the Salt Lake, Uinta, and Green River Basins and around the edge of the upper Snake River Plains, southeastern Idaho, northern Utah, and southwestern Wyoming, extending south in Utah to the head of the Sevier River, east just into Moffat County, Colorado, and rarely across the Divide in Wyoming to the Wind, Sweetwater, and upper North Platte Rivers, west into northeastern Nevada; apparently isolated in the upper Missouri Valley near Helena, Montana.—Map No. 22.—May to August.

ASTRAGALUS CONVALLARIUS (dwelling in valleys) Greene in Erythea 1: 207. 1893, a legitimate substitute for *A. campestris* (Nutt.) Gray in Proc. Amer. Acad. 6: 229. 1894 (quoad nom.; non L., 1753), based on *Homalobus campestris* (dwelling on plains) Nutt. ex T. & G., Fl. N. Amer. 1: 351. 1838.—"Sandy plains of the Colorado of the West, near the sources of the Platte. *Nuttall.*"—Holotypus, labeled by Nuttall "*Homalobus *campestris.* Colorado of the Wt./R. Mts.," BM! isotypi, GH, K, PH!—*Tragacantha campestris* (Nutt.) O. Kze., Rev. Gen. 943. 1891. *Astragalus serotinus* var. *campestris* (Nutt.) Jones in Proc. Calif. Acad. Sci. II, 5: 668. 1895 (quoad nom.). *A. decumbens* var. *convallarius* (Greene) Jones, Contrib. West. Bot. 10: 58. 1902. *Phaca convallaria* (Greene) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 373. 1906 (quoad nom.). *A. convallarius* var. *typicus* Barneby in Leafl. West. Bot. 5: 28. 1947.

Homalobus junceus (rushlike) Nutt. ex T. & G., Fl. N. Amer. 1: 351. 1838.—"With the preceding [i.e., *H. campestris*; cf. supra], and in sandy places in the Rocky Mountain range toward the Oregon . . . *Nuttall.*"—Holotypus, labeled by Nuttall "*Homalobus *junceus.* Colorado of the Wt.," BM! isotypi, K, NY!—*Astragalus junceus* (Nutt.) Gray in Proc. Amer. Acad. 6: 230. 1864; non Ledeb. ex Spreng., 1826. *Tragacantha juncea* (Nutt.) O. Kze., Rev. Gen. 945. 1891. *Astragalus diversifolius* var. *junceus* (Nutt.) Jones, Contrib. West. Bot. 8: 13. 1898. *A. diversifolius* var. *roborum* (of live oaks) Jones, op. cit. 10: 61. 1902, a superfluous substitute.

Astragalus junciformis (rushlike) A. Nels. in Bull. Torr. Club 26: 9. 1898.—". . . near Point of Rocks, Sweetwater Co., Wyoming . . . first secured in 1897, no. 3081, and again, 1898, no. 4839."—Holotypus, *A. Nelson 3081,* collected June 1, 1897, RM! isotypi, NY, US! paratypus, *A. Nelson 4839,* GH!—*Homalobus junciformis* (A. Nels.) Rydb. in Bull. Torr. Club 32: 666. 1905.

Astragalus junceus var. *attenuatus* (drawn out, of the long, slender pod) Jones, Rev. Astrag. 76, Pl. 4. 1923.—"Price, Utah . . ."—Holotypus, collected by Jones, June 24, 1898, POM! isotypus, NY!

To the botanist who travels at all widely during early summer through northern Utah or adjoining parts of Wyoming or Idaho, the lesser rushy milk-vetch must quickly become a familiar or even commonplace member of the foothill flora; and its commonness and modest mien may deny it the appreciation due its many remarkable features. It is not hard, however, to imagine Nuttall's delighted curiosity as he first came across this singular, apparently leafless vetch with its dingy little flowers strung out along filiform or very slenderly tapering axes which resemble the often naked leaf-stalks and thready ultimate branchlets and give rise to pods almost as slender as the stems themselves, laterally compressed and unilocular. At the time of their discovery *Homalobus junceus* and *H. campestris,* which represent no more than slender and robust phases of *A. convallarius,* were a completely novel type of astragaline plant, somewhat resembling in the reduced foliage the so-called *Phaca picta* (our *A. ceramicus*), but bearing a fruit like that of several other *Homalobi* first collected by Nuttall on the same journey.

Variation as now known in var. *convallarius* is rather considerable, especially marked in length of the pod, shape and length of the calyx-teeth, color of the hairs in the inflorescence,

and development or suppression of leaflets in the lower leaves. Various combinations of these characters have served in the past as insecure foundations for maintaining three species (Rydberg, 1929, p. 257, in clave) and Jones's var. *attenuatus,* but these artificially defined propositions do not correspond with biological realities, being more in nature of sporadic minor variants than self-perpetuating races. A more detailed analysis has been published elsewhere (Barneby, 1947, p. 28).

The cited combinations of Nuttall's epithet *campestris* with *Phaca* and *Astragalus* are nomenclatural synonyms only, the substance of what was referred to under these names being in almost all cases some form of *A. miser.* The error arose originally with Gray (1864, l.c.) who misinterpreted *Homalobus campestris* Nutt. in the sense of our *A. miser* var. *oblongifolius.* The plant treated here as *A. convallarius* is Gray's *A. junceus* (1864, p. 230) and includes that of Jones (1923, p. 75) together with his var. *attenuatus.*

50b. Astragalus convallarius var. finitimus

Habit, etc. of var. *convallarius; flowers* small, the banner ± 7.5 mm., wings 7.6–8.4 mm., keel 7.7–8.1 mm. long, the blades of the latter 4.1–4.5 mm. long, ± 2.4 mm. wide; *pod* narrowly oblong, straight, broader and shorter (as given in the key) than in var. *convallarius,* strongly flattened and obscurely torulose when ripe; *ovules* 18–26; *seeds* 2–2.6 mm. long.—Collections: 5 (iii); representative: *Ripley & Barneby 3487, 6407* (RSA); *L. C. Anderson 722* (UTC).

Gravelly and sandy clay hillsides, with sagebrush, piñon and juniper, on limestone, ± 6000–6500 feet, local and apparently rather rare, Highland Range, Lincoln County, Nevada, eats to the north foothills of the Pine Valley Mountains, Washington County, Utah.—Map No. 22.—May and June.

Astragalus convallarius var. finitimus (closely akin) Barneby in Leafl. West. Bot. 7: 192. 1954.—"Utah: 3 miles south of Enterprise, Washington Co., 11 June, 1942, *Ripley & Barneby 4967* . . ."—Holotypus, CAS! isotypus, RSA!

In view of the variability allowed to the pod of var. *convallarius,* the present variety must appear poorly characterized. The fruiting collections examined, all from a compact area lying shortly but disjunctly to the west of the Sevier Valley which marks the southernmost outpost of var. *convallarius,* are alike in the relatively short and broad pod and in the high ovule-number hardly to be expected in so small a fruit. In the outline and proportion of length to width the pod of var. *finitimus* resembles that of *A. diversifolius,* with which the typus was at first confused (Barneby, 1944, p. 148). The resemblance is coincidental, however, for var. *finitimus* has the xerophytic habits and greatly reduced foliage of *A. convallarius.*

50c. Astragalus convallarius var. scopulorum

Similar to var. *convallarius,* but sometimes quite thinly strigulose and greenish, the leaflets more often glabrous above, and the lower leaves more often bearing up to 6 pairs of petiolulate leaflets up to 1–20 mm. long; *racemes* (2) 14–25-flowered; *pedicels* at anthesis (1.6) 2–3 mm., in fruit (2) 2.5–4.5 mm. long; *bracteoles* 0–2; *calyx* 4–6.3 mm. long, black- or partly black-strigulose, the tube (3.5) 3.8–5.4 mm. long, (2.2) 2.5–3.1 mm. in diameter, the teeth 0.5–1.1 mm. long; *petals* bright pink-purple, or whitish tinged with pinkish-lavender, rarely ochroleucous and purple-veined; *banner* (6.6) 8.1–11.2 mm. long; *wings* (7) 9.1–12.6 mm. long; *keel* (6.2) 6.5–9 mm. long, its blades 3.5–4.8 mm. long, 2.2–2.6 mm. wide; *pod* oblanceolate in profile, tapering downward from near the obliquely triangular apex, 2–3.5 cm. long, 2.3–4 mm. in diameter just below the end; *ovules* 11–17; *seeds* 1.8–3.5 mm. long.—Collections: 21 (vii); representative: *Parry 52 in 1864* (NY, POM); *W. A. Weber 3337* (CAS, RSA, WS), *4894* (CAS, OKLA, SMU, TEX, WS); *C. F. Baker 242* (ND, NY, RM, WS); *Ripley & Barneby 5429* (CAS, RSA).

Dry hillsides, gullied banks, and sandy flats, commonly in sagebrush, sometimes in oak woodland, or with piñon and juniper, 5800–8200 feet, locally plentiful and rather common on the west slope of the Colorado Rocky Mountains, from

the White River south to the Gunnison, Rio Blanco to Gunnison County, extending east up the Rio Grande to Middle Park.—Map No. 22.—May to July.

ASTRAGALUS CONVALLARIUS var. SCOPULORUM (of rocks, or by convention of the Rocky Mountains) Barneby in Leafl. West. Bot. 5: 30. 1947.—"COLORADO: . . . 25 miles n. of Loma, Garfield Co., 28 May, 1943, fl. & fr., *Ripley & Barneby 5478*."—Holotypus, CAS! isotypus, RSA!

(?) *Homalobus salidae* (of Salida) Rydb. in Bull. Torr. Club 32: 667. 1905 *("Salidae")*.—"COLORADO: Salida, August 3, 1896, *C. L. Shear 3468*."—Holotypus, NY!—*Pisophaca salidae* (Rydb.)Rydb. in N. Amer. Fl. 24: 325. 1929.

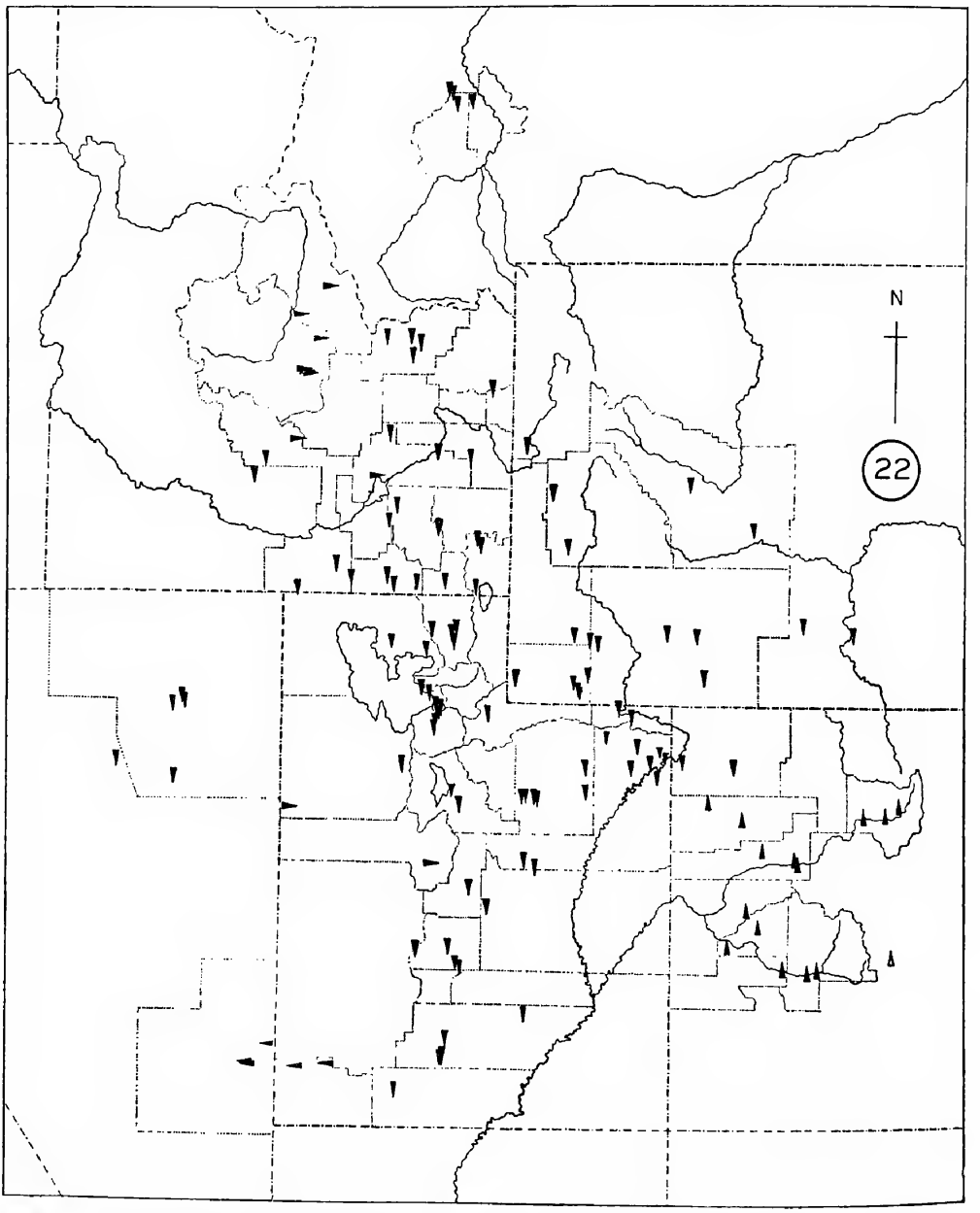
In Gray's annotated copy of his Revision (1864, p. 230, in my library) a note is penciled in his hand against *A. junceus,* showing that he had recognized this species, known hitherto only from Nuttall's typus, in specimens received from the Colorado Rockies, collected by Parry in the same year, in lat. 39–41° N. These are the same Parry specimens cited above as representative of var. *scopulorum* and belong to an entity apparently confined to a small area of the Colorado River watershed lying well to the south of Nuttall's transcontinental route. The average plant of var. *scopulorum* is greener than var. *convallarius* (= *A. junceus* Gray), leafier (with better developed, distinctly jointed leaflets in some early leaves), and at least in the Gunnison and lower Grand River Valleys handsomely purple-flowered; but its best differential character is the oblanceolate rather than linear or linear-acuminate pod which tapers downward very gradually into the calyx from a broad, obliquely triangular apex. In Middle Park and on the White River this characteristic fruit is combined with dingily purple-tinged petals and the sparsely leafy growth-habit of var. *junceus,* and it seems that the two varieties are fully intergradient in northwestern Colorado. The fruits of var. *scopulorum* and of the sympatric *A. miser* var. *oblongifolius* are almost identical in form. Occasionally the two species are found growing together, but they are easily told apart by the position of the root-crown, the different curvature of the petals, and the shape of the keel.

The reduction of *H. salidae* to var. *scopulorum* is not satisfactory and may require correction. The unicate holotypus of *H. salidae* consists of a single stem branching upward from the leafless base and is similar in many respects to var. *scopulorum;* but some lower leaves are composed of up to 21 jointed leaflets, and the pod is extremely slender, scarcely 2 mm. in diameter, becoming subterete when distended by the seeds. The very long pedicels are suggestive of a "grallator" freak (cf. discussion under *A. bisulcatus*), even through the plant is otherwise to all appearances normally developed. The type locality is in the upper Arkansas Valley, thus on the east slope of the Divide from which we have no other example of var. *scopulorum,* and we question whether *H. salidae* may represent a distinct form. Jones (1923, Index) listed *H. salidae* as a synonym of his *A. campestris* (= our *A. miser*), and it is possible that the typus really does represent one of the protean manifestations of *A. miser* var. *oblongifolius.* C. L. Porter (1951, p. 30) referred it doubtfully to *A. diversifolius,* a concept which included the present *A. convallarius.* Rydberg's transfer of *H. salidae* to *Pisophaca,* because of the almost terete ripe pod, has no apparent bearing on its relationships.

51. ASTRAGALUS DIVERSIFOLIUS

Slender, weakly diffuse, with a thick, forking taproot and shortly subterranean, perhaps rarely superficial, ultimately knotty root-crown, strigulose nearly throughout with fine, filiform or somewhat flattened, straight, appressed hairs up to 0.3–0.6 mm. long, the herbage green or greenish-cinereous, the leaflets either pubescent on both sides or nearly glabrous above; *stems* several or numerous, prostrate, or decumbent with weakly ascending tips, 2–5 dm. long, for a short space buried, very slender and leafless, becoming a little stouter upward, branched or spurred at 2–6 of the lowest leaf-bearing nodes, floriferous upward, together forming loosely woven mats; *stipules* dimorphic, the lowest papery-scarious or early becoming so, pallid, brownish, or purple-tinged, amplexicaul and connate through half their length into a loose campanulate sheath 1–2.5 mm. long, the median and upper ones herbaceous, ovate, deltoid, or triangular-lanceolate, (1) 1.5–3 mm. long, embracing ⅓ to the whole stem's circumference, united, if at all, at base only, commonly free; *leaves* (1.5) 2–5.5 (7) cm. long, 1–5 (7)-foliolate, the flattened petiole or rachis and petiole together very short, 2–20 mm. long, the linear-elliptic, linear, oblanceolate, or lanceolate, acute or acuminate leaflets all decurrent on and

continuous with the rachis, the 1–2 (3) lateral pairs 0.4–4.7 cm. long, the terminal one conspicuously longer than the last pair and 1–6.7 cm. long, the grasslike blades either flat or marginally involute, carinate dorsally by the midrib, the lateral leaflets often lacking from some of the lowest and some uppermost leaves, these reduced to a simple, petioled phyllodium; *peduncles* slender, incurved-ascending, (2) 4–15 cm. long, mostly surpassing the leaf; *racemes* loosely (1) 3–8-flowered, the flowers at first ascending, spreading in age, the axis elongating, 0.5–3 cm. long in fruit; *bracts* submembranous, pallid or purplish, ovate or lanceolate, 0.7–2.5



Map No. 22. Parts of the Rocky Mountain and Intermountain States. Range of *A. convallarius*: ▼ var. *convallarius*; ◖ var. *finitimus*; and ▲ var. *scopulorum* (△ type-locality of *Homalobus salidae*); and of ◗ *A. diversifolius*.

mm. long; *pedicels* at anthesis ascending, straight or nearly so, 1.8–3.1 mm. long, in fruit either ascending or geniculate at base and divaricate, little thickened, 2.5–4 mm. long; *bracteoles* 0; *calyx* 4.4–6.7 mm. long, densely strigulose with mixed black and white, largely black, or all white hairs, the subsymmetric disc 0.8–1 mm. deep, the campanulate tube 3.2–4.7 mm. long, 2.5–3.5 mm. in diameter, the subulate or triangular-subulate teeth 1–2 mm. long, the whole becoming papery, marcescent unruptured; *petals* greenish-white, the banner and keel-tip faintly lilac-tinged; *banner* recurved through 50–80°, broadly spatulate, ovate-cuneate, or suborbicular-flabellate, shallowly notched, 8–13.4 mm. long, 6.7–9 mm. wide; *wings* 7.7–12.1 mm. long, the claws 3.2–4.8 mm., the broadly oblanceolate or obliquely obovate, obtuse or emarginate, gently incurved blades 5.1–8.2 mm. long. 2–3.9 mm. wide; *keel* 7.8–11 mm. long, the claws 3.2–5 mm., the lunately elliptic blades 5.1–6.4 mm. long, 2.3–2.8 mm. wide, gently incurved through 80–95° to the triangular, subacute or obtuse, sometimes slightly porrect apex; *anthers* 0.5–0.75 (0.8) mm. long; *pod* either ascending or declined (ordinarily humistrate), sessile or substipitate, the stipe up to 1 mm. long, the body narrowly oblong or very slightly enlarged upward and oblong-oblanceolate in profile, 1–1.7 cm. long, (2.7) 3–4 mm. in diameter, straight or more often slightly decurved, strongly compressed and 2-sided, the thin, green, strigulose valves becoming papery, stramineous, finely cross-reticulate, not inflexed, or inflexed (especially in the distal half) as a rudimentary septum up to 0.4 mm. wide; *dehiscence* apical and downward through both sutures, the valves somewhat elastically coiling; *ovules* 10–16, commonly 14; *seeds* not seen ripe.—Collections: 11 (o); representative: *C. L. Hitchcock 15,615* (NY, RSA, WS); *Hitchcock & Muhlick 11,310* (NY, WTU); *Christ & Ward 14,771* (ID, NY); *Goodding 1084* (G, GH, NY, P, RM); *Geyer 2* (BM, G, GH, K, OXF).

Moist, often alkaline meadows, ditch banks, and swales in the sagebrush zone, 4400–6300 feet, local and apparently quite rare, upper Snake River Plains and valleys of the Lost and Lemhi Rivers in southeastern Idaho, and edge of Salt Lake Desert in northwestern Utah; perhaps also east to the upper South Platte in southern Wyoming, but not collected there in recent times.—Map No. 22.—May to July.

ASTRAGALUS DIVERSIFOLIUS (with dimorphic leaves) Gray in Proc. Amer. Acad. 6: 230. 1864, based on *Homalobus orthocarpus* (with straight pod) Nutt. ex T. & G., Fl. N. Amer. 1: 351. 1838 (non *A. orthocarpus* Bss., 1849).—"With the preceding.," i.e., *H. junceus* and *H. campestris*, "Sandy plains of the Colorado of the West, near the sources of the Platte." and perhaps also "in sandy places in the Rocky Mountain range towards the Oregon . . . *Nuttall.*"—Holotypus, labeled by Nuttall "*Homalobus *orthocarpus.* Colorado R., R. Mts.," BM! isotypi, variably labeled "Platte sources" or "Upper California. R. Mts.," GH, K, NY, PH!—*Astragalus campestris* var. *diversifolius* (Gray) Macbr. in Contrib. Gray Herb., New Ser. 65: 35. 1922. *A. junceus* var. *orthocarpus* (Nutt.) Jones, Rev. Astrag. 76. 1923. *A. junceus* var. *diversifolius* (Gray) Jones, op. cit., Index. 1923. *A. convallarius* var. *diversifolius* (Gray) Tidest. in Proc. Biol. Soc. Wash. 50: 20. 1937.

Astragalus ibapensis (of Ibapah, aboriginal name of Deep Creek) Jones in Zoë 3: 290. 1893 *("Ibapensis").*—"June 23, 1891, Deep Creek Mountains, Western Utah, at 5500 feet."—Holotypus, collected by Jones, POM!—*Atelophragma ibapense* (Jones) Rydb. in Bull. Torr. Club 40: 51. 1913.

Astragalus reclinatus (prone) Cron. in Madroño 7: 79. 1943.—" . . . along roadside two miles south of Dickey, Custer County, Idaho, altitude 6300 ft., July 14, 1941 [*Cronquist*] *3086.*"—Holotypus, MINN! isotypi, DS, GH, IDS, MO, POM, UTC!

The meadow milk-vetch, *A. diversifolius,* is difficult to distinguish from *A. convallarius* by any one consistently effective differential character, and modern botanical opinion has been divided about its status. Ordinarily the leaflets are broader and of thinner texture, but they are sometimes all linear; and the pod, although broader and shorter than that of typical *A. convallarius,* closely resembles that of var. *finitimus* in size and outline. Collectively, nevertheless,

the distinctive morphological features of *A. diversifolius,* seen in relation to a physiological adaptation to a mesophytic habitat, are ampy diagnostic. The superficial appearance of the average population is so striking that the species has been redescribed twice since Nuttall by botanists long familiar with its common xerophytic counterpart.

In Idaho the pod of *A. diversifolius* is precisely like that of Nuttall's original *Homalobus,* and is strictly unilocular. Around the margins of Salt Lake Desert in Juab and Tooele Counties, Utah, the species is represented by a form with pod narrowly septiferous from the dorsal suture, but apparently in no other way different. It was described by Jones as *A. ibapensis* and referred by him to sect. *Atrati* (1923, p. 182), but Rydberg's reduction of it (1929, p. 268) to the synonymy of *A. diversifolius* must be accepted.

In the early days of botanical exploration in the West the meadow milk-vetch was collected twice, by Nuttall on the "Colorado of the West," a term usually signifying the Green River Basin, southwestern Wyoming, and by Geyer on the "south fork of the Platte," which I interpret as a southerly branch of the North Platte rather than the South Platte of today's maps. Apparently the species has not subsequently been collected east of the Continental Divide, or even on the Green River, and it is legitimate to question the correctness of the old labels. Except for two collections from Utah, mentioned above, all our modern collections of *A. diversifolius* are from the valleys of the Lost and Pahsimeroi Rivers in Custer and Lemhi Counties, and from the Snake River Plains in Blaine and Bingham Counties, Idaho, where the species must have lain directly in the path of both Nuttall and Geyer as they traveled westward to the Columbia. However the early travelers in the arid West, who followed streams and whenever possible camped within reach of grass and water, must have had opportunities, now lost forever, of seeing the mesophytic vegetation of the bottom lands and streamsides in pristine condition, and it would be rash to discount the old reports.

XII. Sectio LONCHOCARPI

Caulescent perennials, usually sparsely leafy, often junceous or ephedroid, the stems arising from the buried crown of a woody taproot, leafless at base; *stipules* dimorphic, the lowest relatively large, papery, commonly obtuse and several-nerved, ± adnate to a vestigial petiole and amplexicaul-decurrent around half to the whole stem's circumference, free (or if, exceptionally, connate, then very shortly so and more adnate than connate), the median and upper ones firmer or herbaceous, shorter, narower; *leaves* either imparipinnate with 7–15 (19) leaflets, or the lateral leaflets of some or all leaves reduced in size, number, or both, sometimes obsolete, the terminal one then often continuous with the rachis: *flowers* loosely racemose, variably oriented at full anthesis, variable in size and coloring; *calyx-tube* campanulate or more rarely cylindric; *pedicels* persistent or tardily disjointing with the marcescent calyx and pod; *pod* declined, pendulous, rarely spreading, sessile or stipitate, continuous with the receptacle, mostly linear-oblong or -oblanceolate, sometimes ellipsoid, rarely ovoid-ellipsoid and bladdery, uni- (in one sp. subuni-) locular, the body variably compressed, nearly straight or gently arched down (up) ward, the valves papery or rarely somewhat leathery; *dehiscence* apical and downward through one or both sutures; *ovules* 8–42.—Spp. 15, xerophytes, of the Colorado Basin, the southeastern segment of the Great Basin, 1 endemic to the upper Rio Grande Valley, 1 widespread over the whole of this range and extending beyond it to the upper Pecos and Canadian Rivers in New Mexico and thence north to the Arkansas in Colorado.

The section *Lonchocarpi* was established by Gray to accommodate *A. lonchocarpus* alone. Since then it has been gradually expanded by accretion of new species, but always in directions away from the original species, with the result that *A. lonchocarpus* (together with its close relative *A. Hamiltoni*) has become an atypical member of its own section. However the discovery of *A. Schmollae,* which has a pod like that of *A. lonchocarpus* but pinnate foliage, and of *A. Ripleyi,* which is similar except for the laterally compressed fruit, has bridged the gap between *A. lonchocarpus* and *A. Coltoni,* until now associated by students of the genus with *A. filipes* in sect. *Cusickiani* or its equivalent. Although superficially disparate, especially in the compression of the fruit, the five genuine *Lonchocarpi* seem to form a natural group characterized by relatively large, nodding flowers which give rise to narrow and elongate, always long-stipitate pods.

The genus *Lonchophaca* Rydb. was based on sect. *Lonchocarpi* as expanded by Jones (1923, p. 250) who introduced *A. Osterhouti, A. duchesnensis,* and *A. kaibensis* (= our *A. Episcopus*). The first of this trio has been proved seleniferous and differs from the genuine *Lonchocarpi* in chromosome number, but on purely morphological grounds should be removed to sect. *Pectinati.* The other pair are sharply distinguished from the original *Lonchocarpi* by their smaller, ascending flowers and essentially sessile fruits, and together with *A. lancearius* might be thought to form a separate section. However the recently discovered *A. nidularius* and *A. Harrisonii,* in which the flower of *A. lancearius* is combined with a long-stipitate pod, has served to bridge the gap.

From *A. lancearius* it seems no great step to *A. xiphoides* which, with *A. titanophilus,* forms a third group characterized by yet smaller, again nodding flowers with petals all very strongly incurved in the manner of *A. (Genistoidei) convallarius.* From *A. titanophilus* the passage to *A. pinonis,* and thence to *A. aequalis,* in which the pod has become inflated and bladdery, is not difficult. The two last form a subsect. *Aequales* characterized by pinnate leaves, small, spreading flowers, and acute, breaklike keel-tip. To these four groups of species I have added the curious *A. Cronquistii* in which the leaves are all pinnate and the pod sessile or almost so, trigonously compressed and partially bilocular. Because of the narrow septum it might be sought among the *Strigulosi,* but it has the characteristic stipules of the present section.

Comparison of *A. lonchocarpus* with *A. aequalis* or *A. Cronquistii,* which seem to represent culminating points of divergent evolutionary lines, demonstrates the superficially heterogeneous nature of sect. *Lonchocarpi.* Considered in detail, the subsections will be found to differ from each other in various ways, now in the orientation, size, or form of the flower, now in the compression of the fruit or development of the stipe; but the carpological characters overlap from one group to the next, linking the disparate parts into an indissoluble whole. Physical features shared by all members of the section are few, the important common characters being a subterranean root-crown, free lower stipules united to a vestigial petiole in the form of an imperfectly amplexicual sheath, and a declined or pendulous pod continuous with the receptacle and falling tardily with the disjointing pedicel. The *Lonchocarpi* are advanced xerophytes as shown by the tendency throughout the section toward loss or reduction of lateral leaflets and, in consequence, an ephedroid or rushlike habit of growth.

Affinities of sect. *Lonchocarpi* are not far to seek. The subsect. *Pseudogenistoidei* leads directly into sect. *Genistoidei* and has been placed first in order of arrangement to emphasize the relationship. At the further end of the sequence the genuine *Lonchocarpi* closely approach sect. *Collini* in most characters. No doubt all these groups of species are derived ultimately from some common, even if incalculably remote, homaloboid ancestry.

The majority of *Lonchocarpi* are readily grouped into pairs, the members of which differ from each other in an abrupt, often pronounced modification which may involve either the flower, or the fruit, or the foliage, but seldom more than one of these in a given instance. Thus *A. Episcopus* and *A. lancearius* have almost identical leaves and pods but dissimilar flowers; *A. aequalis* and *A. pinonis* can scarcely be distinguished until the very different pods are fully formed; and *A. titanophilus* and *A. xiphoides* or *A. lonchocarpus* and *A. Hamiltoni* are twins differing principally in foliage characters. Nowhere do we find a clearer view of the diverse courses which evolution has followed in the creation of *Astragalus* species. The implications of this diversity are far-reaching, for they go a long way to discredit the traditional taxonomic structure based principally on structure of the pod.

Key to the Subsections of Sect. Lonchocarpi

1. Pod variably compressed, stipitate or sessile, but if the body or any part of it trigonous or obcompressed, then either stipitate, or at least the upper leaves reduced to the rachis, or both; *pod* strictly unilocular (2)
   2. Flower small, declined at full anthesis, the banner 7.5–9 mm. long, the petals all very strongly and abruptly curved, the banner (as in *A. (Genistoidei) convallarius*) bent backward through ± 100–110°; *keel-tip* obtuse; *pod* sessile, laterally compressed, 2-sided ..... XII (i). Subsect. *Pseudogenistoidei*
   2. Flower mostly larger, the banner commonly over 9 mm. long (if shorter the pod either terete or obcompressed); *banner* recurved through 45–90° (if through more than 60° then the pod subcylindric or bladdery, and the keel-tip acutely triangular and beaklike) (3)
      3. Flower ascending or spreading at full anthesis, if not decidedly ascending then the pod sessile, the banner 8–12 mm. long, and the keel-tip beaklike; *pod* sessile or nearly so, or if stipitate its body ± obcompressed and the petals purplish (4)
         4. Flower horizontal at full anthesis, and the banner recurved through ± 90°; *keel-tip* acutely triangular, beaklike; leaves all imparipinnate, with jointed

leaflets; *pod* (subsessile) either terete or bladdery ..... XII (iii). Subsect. *Aequales*

4. Flower ascending at anthesis, the banner gently recurved through 45–50°; *keel-tip* obtuse; *leaves,* or some of them, with decurrent terminal and lateral leaflets, the latter commonly few, small, or absent in some upper leaves; *pod* (sessile or stipitate) never inflated, variably compressed, subterete only in markedly junceous species with many leaves reduced to the naked rachis ..... XII (iv). Subsect. *Lancearii*

3. Flower nodding at full anthesis, the banner (12–24 mm. long) recurved through ± 35–50°; *keel-tip* obtuse; *pod* long-stipitate, the stipe (3) 4–15 mm. long, the body either laterally or dorsiventrally compressed, laterally so if the flowers purple ..... XII (v). Subsect. *Lonchocarpi*

1. Pod sessile and trigonously compressed, grooved dorsally, subunilocular, a narrow partial septum present; *leaves* all regularly pinnate, with 3–7 pairs of articulate leaflets; local in San Juan County, Utah ..... XII (ii). Subsect. *Pseudostrigulosi*

XII (i) Subsectio Pseudogenistoidei

Flowers small, declined or nodding at full anthesis; *banner* ± 7–9 mm. long, very strongly recurved through 100–130°; *keel* 7–8 mm. long, the blades incurved through 100–110° to the bluntly triangular apex; *pod* declined or pendulous, sessile, linear or narrowly lance-oblong in profile, laterally compressed, bicarinate by the sutures, ± 2–4 cm. long, the valves papery; *dehiscence* apical and downward through both sutures, the valves separating elastically and often coiling outward; *ovules* 14–24.—Spp. 2, of northern Arizona.

Astragalus sect. Lonchocarpi subsect. Pseudogenistoidei, subsect. nov., inter *Lonchocarpos* floribus parvulis declinatis, petalis omnibus more *A. convallarii* Greene abrupte incurvis, legumine de latere compresso sessili insignes; a sect. *Genistoideis* vix nisi stipulis inter se liberis distincta subsectio fortasse nimium artificialis sistit.—Sp. typica: *A. xiphoides* Barneby.

Key to the Species of Subsect. Pseudogenistoidei

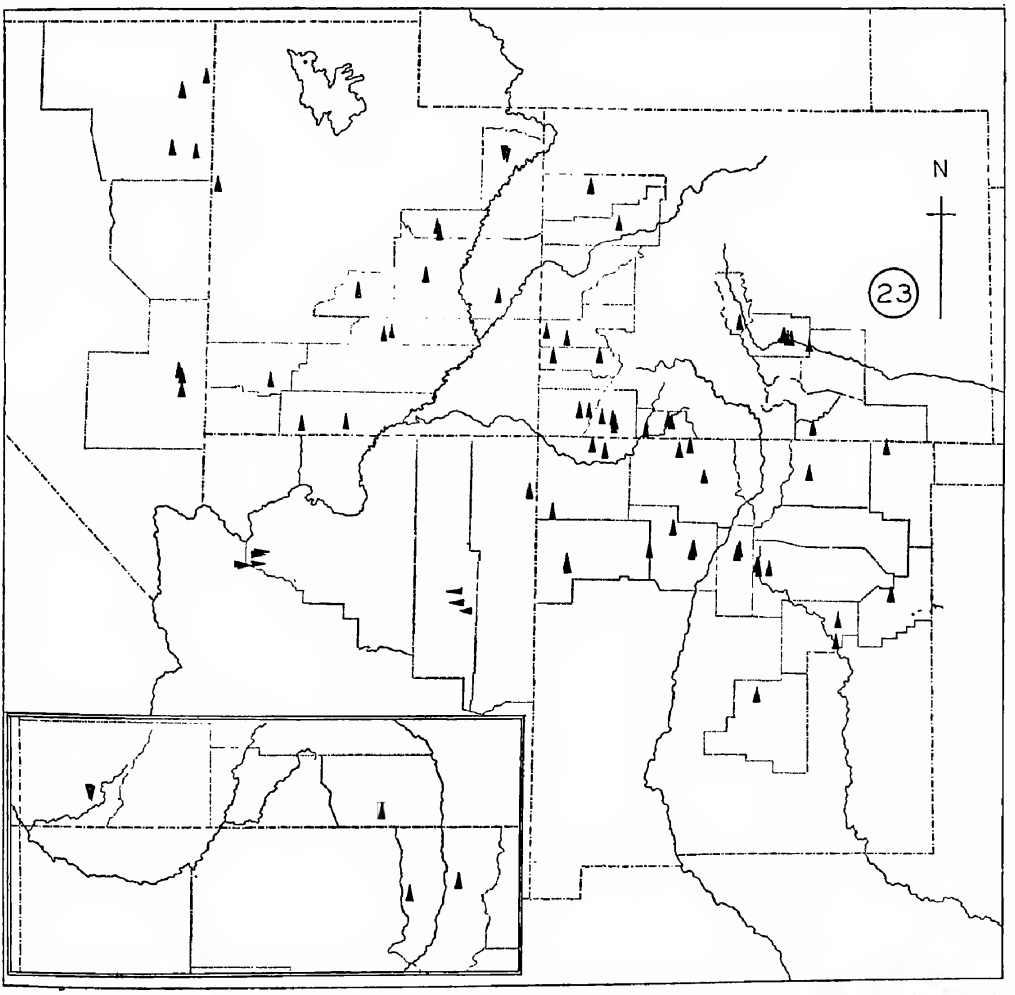
1. Leaves all imparipinnate, with 7–15 distant and narrow but articulate leaflets; n.-w. Arizona ..... 52. *A. titanophilus*

1. Leaves irregularly pinnate, some or nearly all reduced to a leafless rachis, others with 1–2 (3) pairs of scattered leaflets decurrent into the rachis; n.-e. Arizona ..... 53. *A. xiphoides*

52. Astragalus titanophilus

Slender and wiry, gray-strigulose throughout with fine, filiform, or flattened and scalelike, appressed hairs up to 0.3–0.45 mm. long, the leaflets either equally pubescent on both sides or (more rarely) medially glabrescent above; *stems* few, usually 3–6, weakly assurgent or almost prostrate, 1.5–3 dm. long, subterranean for a space of (1) 2–7 cm., either simple or divaricately branched at 1–2 nodes preceding the first peduncle, naked and purplish at base, floriferous upward from near or shortly above the middle; *stipules* 2–8 mm. long, strongly dimorphic, the lowest large, papery, pallid or purplish-brown, several-nerved, oblong-obovate, obtuse, adnate to the vestigial petiole and decurrent-amplexicaul around half to the whole stem's circumference, the upper ones smaller, firm, deltoid-acuminate or triangular, not more than semiamplexicaul; *leaves* (2.5) 3.5–9 cm. long, with 7–15 distant, linear or linear-oblong, obtuse or emarginate, flat or loosely involute leaflets 2–12 (16) mm. long, all jointed to the rachis; *peduncles* ascending, or divaricate and incurved, 3.5–9.5 cm. long; *racemes* loosely secund, (3) 7–17 (20)-flowered, the axis elongating, (2) 4–14 cm. long in fruit; *bracts* ovate or triangular-lanceolate, 0.8–2 mm. long; *pedicels* at anthesis slender, widely spreading or a trifle arched downward, 2–3.5 mm. long, in fruit either straight and widely ascending or horizontally spreading, or variably declined, recurved, or contorted, a trifle thickened, 2.8–6 mm. long; *bracteoles* usually 0, minute when present; *calyx* 4–5.9 mm. long, strigulose with mixed black and white or all black hairs,

the subsymmetric disc 0.6–1 mm. deep, the campanulate tube 3.2–4.5 mm. long, 2.6–3.2 mm. in diameter, the subulate or deltoid-triangular teeth 0.5–1.4 mm. long; *petals* ochroleucous tinged and veined with lilac, or pale pinkish-white fading ochroleucous, little or somewhat irregularly graduated, all very strongly incurved; *banner* broadly ovate- or suborbicular-cuneate, shallowly notched, 7.3–8.5 mm. long, 5.2–6.6 mm. wide; *wings* (0.2 mm. shorter to 0.7 mm. longer) 7–8.5 mm. long, the claws 3.7–4.4 mm., the lunately oblong-oblanceolate, obtuse, strongly incurved blades 4–5 mm. long, 2.2–2.4 mm. wide; *keel* 7–8 mm. long, the claws 3.7–4.4 mm., the broadly half-elliptic or almost half-circular blades 4–4.5 mm. long, 2.6–2.8 mm. wide; *anthers* 0.65–0.75 mm. long; *pod* loosely declined or pendulous, subsessile but cuneately contracted at base into a stout, stipelike neck 1–1.5 mm. long, the body linear-oblong or -elliptic in profile, straight or gently in- or decurved, (1.8) 2.2–3.5 cm. long, 3.2–4.6 (5) mm. in diameter, cuneate or acuminate and shortly cuspidate at apex, laterally compressed and (especially when young) bicarinate by the sutures, the faces at first flat, becoming distended and convex at maturity, the thinly fleshy, at first green or purplish, densely strigu-



Map No. 23. Utah, Colorado, New Mexico, and parts of adjoining states. Range of ▲ *A. lonchocarpus*; of ▼ *A. Hamiltoni*; of ◆ *A. xiphoides*; and of ◗ *A. titanophilus*. Inset, lower left, parts of northwestern New Mexico and southwestern Colorado. Range of ▲ *A. Ripleyi;* and of ▼ *A. Schmollae.*

lose valves becoming rather stiffly papery, brownish-stramineous; *ovules* (16) 20–24; *seeds* brown, often purple-speckled, sparsely pitted, sublustrous, 2.6–3.1 mm. long.—Collections: 6 (iv); representative: *Ripley & Barneby 5223* (ARIZ, CAS, RSA), *7071* (RSA).

Sandy or gravelly clay flats and low stony hills, with piñon and juniper, on soils derived from decomposing limestone, 4450–6000 feet, locally plentiful on the plateau south of Grand Canyon about the common boundary of Coconino, Mohave, and Yavapai Counties, Arizona.—Map No. 23—Late April to July.

ASTRAGALUS TITANOPHILUS (lime-loving) Barneby in Amer. Midl. Nat. 55: 477. 1956, based on *A. convallarius* var. *foliolatus* (furnished with leaflets, in contrast to *A. convallarius*) Barneby in Leafl. West. Bot. 5: 31. 1947.—"ARIZONA: ... 16 miles southwest of Frazier's Wells, alt. 5800 ft., 13 May 1943, *Ripley & Barneby No. 5229*."—Holotypus, CAS! isotypi, ARIZ, GH, NY, POM, RSA!

The limestone milk-vetch, *A. titanophilus,* closely resembles *A. convallarius* in superficial appearance, and the likeness is borne out by details of the poorly graduated and very strongly incurved petals. It differs consistently in its free lower stipules as well as in the regularly imparipinnate leaves which provide an immediately apparent differential character. In growth-habit and details of the foliage *A. titanophilus* simulates *A. pinonis* of the next subsection, but this may be distinguished in flowering specimens by the shorter pedicels (1–2 mm. long at anthesis) and the beaked keel-petals, and subsequently by the broader, somewhat tumid, almost terete pod 5.5–8.5 mm. as opposed to 3–5 mm. in diameter. The closest relative of *A. titanophilus* is the species next in order, *A. xiphoides,* which has almost the same flower but differs greatly in the reduced foliage and more strongly flattened, bladelike pod. The restricted ranges of the two *Pseudogenistoidei,* both endemic to northern Arizona, are separated by a gap of some 180 miles. The limestone milk-vetch was first collected in 1893, near Peach Springs, by E. L. Greene (ND).

53. ASTRAGALUS XIPHOIDES

Slender, sparsely leafy or apparently leafless, strigulose-cinereous with fine, straight, appressed hairs up to 0.3–0.5 mm. long; *stems* few, 3–4.5 dm. long, diffuse and weakly ascending, subterranean for a space of 2–6 cm., branched at the first 2–3 nodes above ground and the more robust branches often again branched, floriferous upward from near or well below the middle, the first 1–2 fertile nodes sometimes bearing paired peduncles of unequal length; *stipules* 2–7 mm. long, the lowest ones large, ovate, obtuse, several-nerved, early becoming papery, decurrent-amplexicaul around half to nearly the whole stem's circumference, the median and upper ones smaller, firm, triangular or broadly lanceolate, erect; *leaves* 2.5–13 cm. long, either all reduced to the linear-filiform or sometimes apically dilated and recurved rachis, or some of them bearing 1–2 (3) pairs of scattered, linear-involute, decurrent leaflets 3–17 mm. long; *peduncles* ascending, 3.5–7.5 cm. long, the early ones stout, the uppermost slender or filiform, all shorter than the leaf; *racemes* loosely or remotely (3) 7–17 (35)-flowered, secund or becoming so, the axis elongating and (2) 4–18 (33) cm. long in fruit; *bracts* firm, triangular-lanceolate, 1.2–2.6 mm. long; *pedicels* slender, at anthesis ascending and gently arched outward, 2–4.5 mm. long, in fruit horizontally spreading from the twisted base, loosely recurved, or abruptly refracted, somewhat thickened, 5–8 mm. long; *bracteoles* 0–2; *calyx* 4.6–6 mm. long, white-strigulose, the scarcely oblique disc 0.6–0.8 mm. deep, the campanulate tube 3.8–4.1 mm. long, ± 2.8 mm. in diameter, the subulate or triangular-subulate teeth 0.8–1.9 mm. long; *petals* ochroleucous, immaculate, little or somewhat irregularly graduated, all very strongly incurved; *banner* ovate-cuneate, emarginate, or entire and obscurely acuminate at apex, ± 9 mm. long, 4.6–6 mm. wide; *wings* (as long or a trifle longer) 8.9–9.3 mm. long, the claws 3.6–3.8 mm., the lunately oblong-elliptic, obtuse, strongly incurved blades 6–6.3 mm. long, 2.5 mm. wide; *keel* ± 8 mm. long, the claws 3.6–3.8 mm., the lunately half-obovate blades 4.7–5 mm. long, 2.6–2.7 mm.

wide; *pod* declined or pendulous, sessile, narrowly lance-oblong in profile, straight or nearly so, 2.5–3.7 (4) cm. long, 4–5.5 mm. in diameter, cuneate at both ends but more broadly so at base, shortly cuspidate at apex, strongly compressed, bicarinate by the filiform sutures, the faces flat or nearly so, the thin, pale green but densely strigulose valves becoming papery and stramineous; *ovules* 14–18; *seeds* brown, smooth but dull, 2.5–3 mm. long.—Collections: 4 (i); representative: *Wiegand & Upton 3618* (MO); *Goodding 4–45* (ARIZ); *Hough 37* (US).

Broken sandstone and clay bluffs, ± 5200 feet, apparently rare and very local, known only from the valley of the Little Colorado River in the neighborhood of Holbrook, Navajo County, Arizona.—Map No. 23.—Late April to early June.

ASTRAGALUS XIPHOIDES (Barneby) Barneby in Amer. Midl. Nat. 55: 477. 1956, based on *A. convallarius* var. *xiphoides* (swordlike, of the flat, two-edged pod) Barneby in Leafl. West. Bot. 5: 30. 1947.—"ARIZONA: . . 5 miles northeast of Holbrook . . *Ripley & Barneby 5246*."—Holotypus, collected May 15, 1943, CAS! isotypi, ARIZ, GH, NY, RSA!

The gladiator milk-vetch, *A. xiphoides*, is a characteristic desert switch-plant, the diffuse, pliant, apparently leafless stems pivoting before the wind on a central axis which by repeated movement forms a narrow funnel-shaped blowhole in the sand. The flowers are inconspicuous enough, on account of their small size and scattered arrangement, but are made doubly so by their strawlike pallor which blends into the background of tawny sandstone. The species might be described as combining the short, greatly incurved flower of *A. convallarius* (which is not known to extend south into Arizona) with the flat bladelike pod of *A. lancearius* or *A. Episcopus*, and seems to form a transition between sects. *Lonchocarpi* and *Genistoidei*. Fruiting specimens of *A. xiphoides* could be distinguished from *A. Episcopus* (not known to extend east of Coconino County in Arizona) by the proper peduncle being shorter, not much longer than the subtending leaf.

An astragalus from Gallup, New Mexico, reported as *A. diversifolius* by Wooton & Standley (1915, p. 365) I provisionally identified as *A. xiphoides* and cited as such (1956, l.c.). This collection (*Herrick 812*, NMC) has proved to belong to a junceous state of *A. wingatanus*, leaving *A. xiphoides* as a narrow endemic of central Navajo County.

XII (ii). Subsectio PSEUDOSTRIGULOSI

Leaves all imparipinnate, the 7–15 leaflets all jointed; *flowers* small, nodding, the banner ± 8 mm. long, incurved through ± 90°; *keel-blades* ± semicircular, the tip sharply deltoid; *pod* deflexed, sessile or nearly so, linear-ellipsoid, bluntly trigonous, openly grooved dorsally, the valves inflexed as a narrow septum less than 1 mm. wide; *ovules* 16.—Sp. 1, of s.-e. Utah.

ASTRAGALUS sect. LONCHOCARPI subsect. PSEUDOSTRIGULOSI, subsect. nov., inter *Lonchocarpos* foliis omnibus imparipinnatis legumine trigono dorso sulcato subuni- (nec prorsus uni-) loculari insignes. Habitu ac legumine *Strigulosos* nunnullos simulant sed imprimis stipulis imis imperfecte amplexicaulibus petiolo vestigiali adnatis nec vero inter se connatis absimiles.—Sp. unica: *A. Cronquistii* Barneby.

54. ASTRAGALUS CRONQUISTII

Diffuse, perennial, with a stout taproot and buried root-crown, strigulose with subappressed (and a few narrowly ascending), filiform or flattened and scalelike hairs up to 0.2–0.5 mm. long, the stems cinereous distally, the herbage bicolored, the leaflets gray and densely pubescent beneath, yellowish-green and glabrous to thinly and minutely pubescent above; *stems* several, decumbent and radiating, (1.5) 2–4 dm. long, subterranean for a space of 5–14 cm., simple or divaricately branched or spurred at 1–3 nodes preceding the first peduncle, floriferous upward from near or above the middle; *stipules* 2–6 mm. long, dimorphic, those at the buried nodes papery, pallid or brownish, adnate to the vestigial petiole to form a bidentate sheath embracing ± ¾ the stem's circumference, the upper ones herbaceous, deltoid to triangular, often spreading or deflexed; *leaves* 1.5–4.5 cm. long, mostly divaricate or recurved, sessile or nearly so, with 7–15 oblong-elliptic to

linear-oblong, deeply retuse to truncate-emarginate, flat or loosely folded leaflets 6–20 (23) mm. long; *peduncles* divaricate and incurved-ascending, 2–6.5 cm. long; *racemes* loosely 6–20-flowered, the flowers nodding at full anthesis, the axis (1.5) 2–6.5 (8.5) cm. long in fruit; *bracts* triangular-subulate, 0.6–1.2 mm. long; *pedicels* at anthesis arched outward, in fruit ascending at a wide angle, divaricate, or recurved, thickened, 2–2.5 mm. long, tardily disjointing with the fruit; *bracteoles* 0; *calyx* ± 4 mm. long, strigulose with white and sometimes a few fuscous hairs, the campanulate tube ± 3–4 mm. long, 2.2–2.5 mm. in diameter, the broadly subulate or triangular teeth 0.5–1 mm. long, separated by wide, obtuse sinuses, the whole becoming papery, ruptured, persistent; *petals* pink-purple, the wing- and keel-tips paler; *banner* recurved through 90–100°, broadly obovate-cuneate, openly notched, ± 8 mm. long, 5.5 mm. wide; *wings* nearly as long, the claws ± 4 mm., the obovate, obtuse or subemarginate, incurved blades ± 5 mm. long; *keel* nearly as long as the banner, the claws 4–4.5 mm., the almost half-circular blades ± 4 mm. long, 2.6–3 mm. in diameter, incurved through 100–120° to the sharply deltoid apex; *pod* declined or pendulous, sessile or contracted at base into an incipient stipe up to 0.8 mm. long, the body linear-elliptic, linear, or obscurely linear-oblanceolate in profile, straight to gently incurved (rarely a trifle decurved), (2) 2.2–3 cm. long, 3.5–4.8 mm. in diameter, bluntly trigonous, keeled ventrally by the prominent suture, openly grooved dorsally, the lateral faces low-convex, the lateral angles rounded, the thin, green or faintly red-dotted, strigulose valves becoming stramineous, papery, cross-reticulate, inflexed as a rudimentary septum 0.3–0.6 mm. wide; *dehiscence* unknown; *seeds* oblong or prismatic, greenish-brown and purple-dotted, pitted but sublustrous, 3.6–4.8 mm. long.—Collections: 2 (o); representative: *Welsh 1505* (NY).

Low sandy and gravelly ridges, on red sandstone, ± 4000 feet, known only from the type-locality and vicinity in Comb Wash west of Bluff, San Juan County, Utah.—Map No. 24.—Late April to May.

ASTRAGALUS CRONQUISTII (Arthur John Cronquist, 1919–), sp. nov., nulli arcte affinis, inter *Lonchocarpos* ob stipulas imas (subterraneas) petiolo vestigiali adnatas inter se liberas et legumen pendulum persistens collocanda, foliis imparipinnatis *A. titanophilum* necnon subsect. *Aequales* simulans sed ab illis legumine trigono dorso sulcato cito diagnoscenda. Species ab omnibus *Lonchocarpis* (praeter *A. Coltoni* formis raris) legumine septo angusto sed facile observato subuniloculari diversa et hac nota *Strigulosis* nonnullis (e.g., *A. cobrensi*) similis, sed stipularum forma cum eis incongrua.—Perennis diffuse adscendens, appresse strigulosa, caulibus e radicis collo subterraneo 2–4 dm. longis, foliolis oblongis 3–7-jugis omnibus (ut terminali) articulatis, racemis laxis 6–20-floris, floribus parvulis calyce 4–4.5 mm., vexillo carinaque subaequilongis ± 8 mm. longis, legumine pendulo, subsessili, anguste lineari-ellipsoideo subrecto 2–3 cm. long, obtuse triquetrim compresso, ventre carinato dorso aperte sulcato, valvulis chartaceis strigulosis anguste introflexis septo 0.3–0.6 mm. lato.—UTAH: in desert along west side of Comb Wash, 9 miles west of Bluff, San Juan County, May 27, 1961, *Cronquist 9123*.—Holotypus, NY! isotypi 9 distributuri.

The Cronquist milk-vetch is a modest astragalus but one of great theoretical interest. It stands apart from all other *Lonchocarpi* because of its regularly pinnate foliage combined with a subsessile, trigonously compressed pod the cavity of which, unlike that of other members of the section (except rarely in *A. Coltoni*), is partially divided into two chambers by a narrow septum. In general appearance *A. Cronquistii* does not suggest the normally ephedroid or at least sparsely leafy *Lonchocarpi* as much as some members of sect. *Scytocarpi* or sect. *Strigulosi*. The habit of growth, subterranean root-crown, sheathing lower stipules, and bicolored leaflets recall some forms of *A. (Scytocarpi) flexuosus* or *A. (Strigulosi) cobrensis*, and the trigonous, subunilocular pod also suggests an affinity to the *Strigulosi*. However, the lower stipules in both these sections are fully amplexicaul and connate opposite the petiole into a cuplike sheath, quite different from those of sect. *Lonchocarpi* which are united to a vestigial petiole but only about three-fourths amplexicaul. No *Strigulosi* are known to occur in Utah; they are a southern group, largely Mexican, and none really resembles *A. Cronquistii* in fine detail. Two small-flowered *Scytocarpi* are more or less closely sympatric with *A. Cronquistii*

and occur at similar elevations and in like habitats. One of these, *A. flexuosus* var. *Diehlii,* has flowers nearly one half smaller and pods, of course unilocular, scarcely half as long. The other, with flowers of about the same size, is *A. fucatus,* a species common on dunes between Bluff and Mexican Hat; although this resembles the Cronquist milk-vetch closely in habit, it is very different in its bladdery-inflated, gaily mottled pod.

The affinities of *A. Cronquistii* are controversial. Judged principally by the pod, it would fit most easily into sect. *Strigulosi,* but would be anomalous there on account of the stipules. The pod's trigonous compression can be matched very nearly in *A. (Lonchocarpi) nidularius,* so that the only feature foreign to the present section (or nearly so; cf. a rare form of *A. Coltoni,* mentioned below) is the incipient septum in the pod. As a rule the form of the stipules, especially low on the stems, provides a more reliable clue to kinship in *Astragalus* than do many features of the pod. Stipules have no apparent role in the survival of the species and yield seldom and reluctantly to evolutionary progress, whereas the pod is modified with almost every evolutionary step at the specific level. A septum, whether developed or not in a given species, seems to be latent in the gene-stream of the genus, ready to crop out in the most unforeseen places and, conversely, as abruptly disappearing in particular cases. The Cronquist milk-vetch combines features of sects. *Lonchocarpi* and *Scytocarpi,* groups which are certainly close kindred. Selection of the right genes from the nearly sympatric *A. (Scytocarpi) fucatus* and *A. (Lonchocarpi) nidularius,* which is found only a little way distant in White Canyon, might produce a plant resembling *A. Cronquistii.* The ample material is very uniform and cannot be interpreted as a recent hybrid, but the species may be a recombination type in which one primitive character (the septum), latent in the prognitors, has reappeared. In any case *A. Cronquistii* is so distinct that it must figure as typus of a monotypic subsection.

XII (iii). Subsectio Aequales

Flower small (the banner ± 8–12 mm. long), horizontally spreading at full anthesis, declined thereafter; *banner* recurved through ± 90°; *keel-blades* oblong-obovate in the lower ⅔, thence abruptly incurved through 85–100° into a prominent, narrowly triangular, slightly porrect beak; *pod* spreading or declined, subsessile, narrowly to broadly ellipsoid, tumescent or greatly inflated, terete or a trifle dorsiventrally compressed; *ovules* (19) 26–42. Leaves imparipinnate, the leaflets all jointed.—Spp. 2, of southern and eastern Nevada, western Utah, and northwestern Arizona.

Astragalus sect. Lonchocarpi subsect. Aequales, subsect. nov., inter *Lonchocarpos* parvifloros foliis imparipinnatis, floribus ad anthesin patulis, carinae apice triangulari rostriformi, et legumine subsessili anguste fusiformi subtereti vel ovoideo vesicario-inflato notabiles. —Sp. typica: *A. aequalis* Clokey.

Key to the Species of Subsect. Aequales

1. Pod narrowly oblong-ellipsoid, merely tumid, 2–3.5 cm. long, 5.5–8.5 mm. in diameter; *banner* 8.2–10.3 mm. long; s.-e. and e.-centr. Nevada to w. Utah, the ovules in this area 32–42; also apparently in n.-w. Arizona (but the ovules only ± 20) ..... 54. *A. pinonis*

1. Pod broadly ovoid-ellipsoid, bladdery-inflated, 2.5–4 cm. long, 1.2–2 cm. in diameter, 26–33-ovulate; *banner* 11.5–12 mm. long; Charleston Mountains, s. Nevada ..... 55. *A. aequalis*

55. Astragalus pinonis

Usually slender, weak, few-stemmed, sparsely leafy, strigulose throughout with straight or nearly straight, appressed hairs up to 0.2–0.5 mm. long, the herbage gray or greenish-cinereous, the leaflets pubescent on both sides but bicolored, yellowish-green beneath the vesture above; *stems* solitary or 2–4 (5), arising from the root-crown shortly below soil-level, in open places erect or straggling but commonly supported by sagebrush, (1) 1.5–6 dm. long, leafless and purplish in the lower ⅓, either simple or bearing divaricate branches at the first few leaf-bearing nodes, usually zigzag distally; *stipules* 1.5–5 mm. long, dimorphic, the lowest ovate, obtuse, papery, chestnut-purple, adnate to the vestigial petiole and decurrent-amplexicaul around ½–⅔ the stem's circumference, the upper ones herbaceous,

small, deltoid or triangular-subulate, sometimes deflexed; *leaves* usually divaricate, 2–8 (11) cm. long, the uppermost subsessile, with 9–15 (19) linear to linear-oblong or -oblanceolate, obtuse or retuse leaflets (2) 4–16 (19) mm. long; *peduncles* either divaricate or widely incurved-ascending, (1.5) 3–8 cm. long; *racemes* loosely 5–19-flowered, the axis somewhat elongating, 2–7 cm. long in fruit; *bracts* membranous, pallid or purplish, ovate or ovate-acuminate, 1–2 mm. long; *pedicels* at anthesis 1–2 mm. long, in fruit arched outward, thickened, (1.5) 2–3 mm. long; *bracteoles* 0 (rarely a minute scale); *calyx* 4.3–5.6 mm. long, strigulose with black, white, or mixed black and white hairs, the subsymmetric disc 0.8–1.3 mm. deep, the campanulate tube 2.3–3.8 mm. long, 2.5–3.3 mm. in diameter, the broadly subulate teeth 1–2 mm. long, the ventral pair often broadest; *petals* greenish-white or sordidly ochroleucous, commonly tinged distally, and the banner veined, with dull lilac; *banner* suborbicular-cuneate, emarginate, 8.2–10.3 mm. long, 7–9 mm. wide; *wings* 8–9.8 mm. long, the claws 3–3.8 mm., the broadly and obliquely obovate or broadly oblanceolate, obtuse or erose-emarginate blades 5.1–6.6 mm. long, 2.3–3 mm. wide; *keel* 7.5–9.7 mm. long, the claws 3.1–4 mm., the blades 4.8–6.2 mm. long; anthers 0.6–0.7 mm. long; *pod* spreading or loosely declined; subsessile or elevated on an obscure, glabrous, stipelike neck up to 1 mm. long, the body narrowly oblong-ellipsoid, straight or a trifle incurved, 2–3.5 cm. long, 5.5–8.5 mm. in diameter, cuneate at base, abruptly acute and cuspidate at apex, terete or a little dorsiventrally compressed, obtusely carinate by the thick, prominent sutures, the somewhat fleshy, brown- or purple-tinged, densely strigulose valves becoming stiffly papery, brownish-stramineous and coarsely reticulate; *dehiscence* apical and downward through the ventral suture; *ovules* (19–20) 32–42; *seeds* (seldom seen) brown, smooth, ± 1.7 mm. long (probably sometimes longer).—Collections: 17 (viii); representative: *Maguire & Holmgren 25,528* (CAS, NY, RSA, UTC, US, WS); *Ripley & Barneby 6333* (CAS, RSA), *6260, 6271, 6304* (RSA).

Dry hillsides and valley floors, in stiff or loose, sandy clay soils derived from limestone, nearly always taking shelter under and scrambling up through low sagebrush, more rarely on open slopes with piñon and juniper, 5200–7400 (reportedly 8000) feet, uncommon and nowhere abundant, eastcentral Nevada (White Pine Mountains south to the Quinn Canyon and Highland Ranges, White Pine, northwestern Nye and northern Lincoln Counties) and western Utah (Frisco Mountain, central Beaver County; Tintic, western Juab County); apparently also in the foothills of the Kaibab Plateau, Coconino County, Arizona.—Map No. 25.—May to July.

ASTRAGALUS PINONIS (of the piñon or nut pine) Jones, Contrib. West. Bot. 8: 14. 1898 (*"Pinonis"*).—"Frisco, Utah, June 22, 1880, at about 8000 ft. alt. . . ."—Holotypus, dated 1888, POM!—*Pisophaca pinonis* (Jones) Rydb. in N. Amer. Fl. 24: 325. 1929.

The piñon milk-vetch is widely dispersed through the limestone mountains of eastern Nevada, but it is a relatively rare astragalus nevertheless, found usually in small, scattered colonies. The apparent scarceness of individuals may be due, in part, to the inconspicuous nature of the plants and their habit of growing up through twiggy entanglements of low sagebrush *(Artemisia arbuscula)*, by which all but the racemes of small, pallid or faintly lilac-tinged flowers and the narrow spindles of the fruit are concealed from view. The species was known to Jones (1923, p. 196, Pl. 44) and to Rydberg (1929, p. 325) only from meager material from Utah, the two collections from which Jones drew the original description in 1898; it was mistakenly referred to sect. *Flexuosi* or *Pisophaca* (= our sect. *Scytocarpi*) on account of the narrow subterete unilocular pod. Jones voiced a suspicion that when better known it might prove to belong in sect. *Lonchocarpi*, of which it is now known to have all important features.

Two collections from Arizona (South Canyon, south of House Rock Valley, Coconino County, *Goodding 92–49*, ARIZ, CAS; Kaibab Forest, *B. Swapp 37*, BRY) have been identified tentatively as *A. pinonis*, but possibly represent an allied species or a distinct variety. The first

has flowers only, the second no more than one pod, of which the compression is not clear. The terminal leaflets of some leaves are continuous with the rachis, and in Goodding's plant the ovules are only 19–20 in contrast to 32–42 characteristic of the Nevada plant. The flower is apparently that of subsect. *Aequales,* with beaklike keel-tip. More material is required.

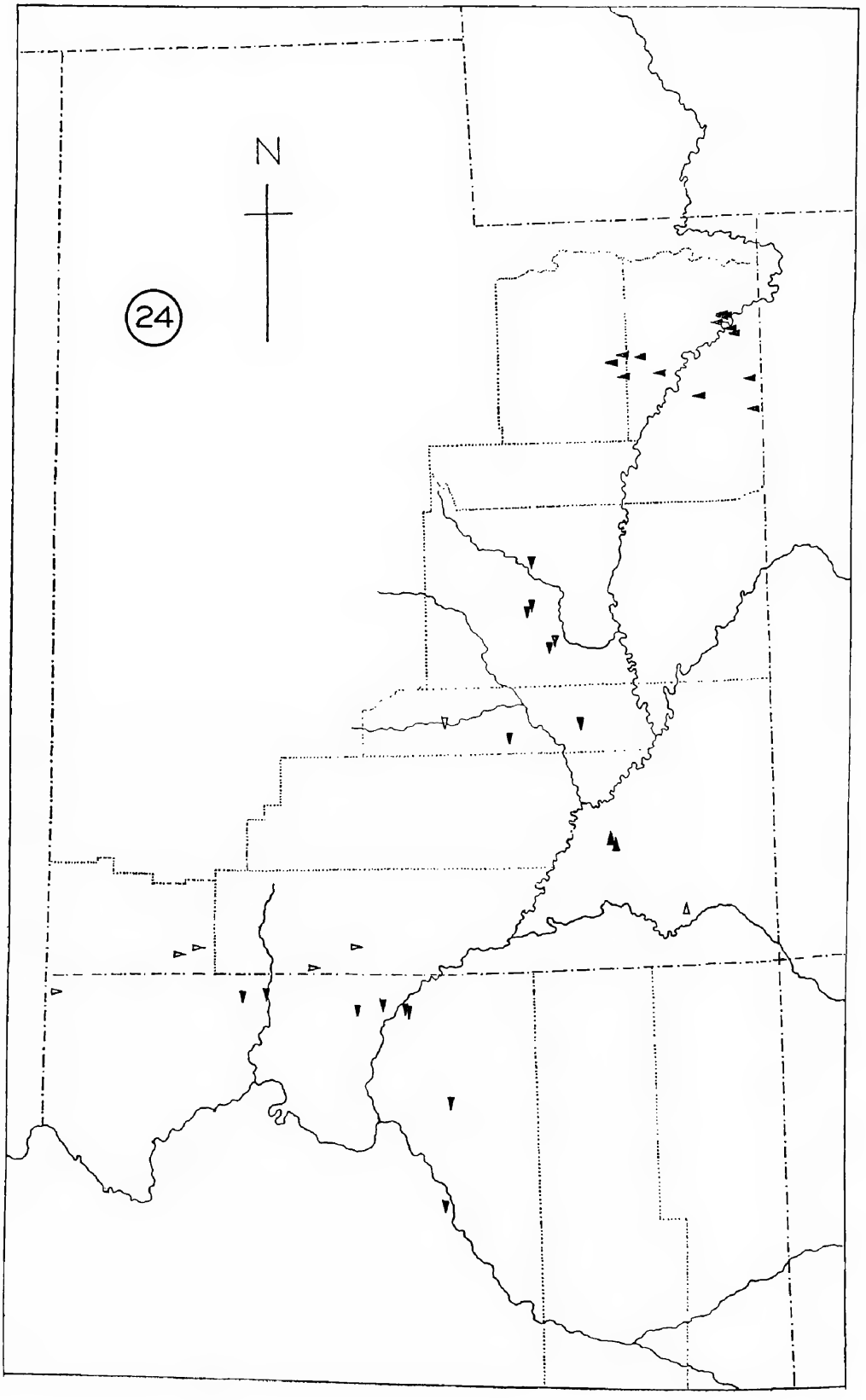
56. Astragalus aequalis

Slender, sparsely leafy, closely resembling *A. pinonis* up to the fruit, strigulose throughout with closely appressed, somewhat flattened hairs up to 0.35–0.45 mm. long, the herbage greenish or cinereous; *stems* few, diffuse or ascending, 2–5 (6.5) dm. long, naked, purplish and subterranean for a space of (0) 1–4 cm., simple or bearing branches or spurs at 1–3 nodes preceding the first peduncle, flexuous or zigzag distally; *stipules* 1.5–4.5 mm. long, dimorphic, the lowest ones papery-membranous, oblong-ovate, obtuse, pallid or purplish, strongly adnate to the vestigial petiole and decurrent around ¾ to the whole stem's circumference, free (rarely shortly and obscurely connate), the upper ones herbaceous, shorter and narrower, triangular, subacute, the blades often reflexed; *leaves* 2.5–9 (12) cm. long, shortly petioled, with 9–15 linear, linear-lanceolate, or -oblanceolate, rather distant leaflets 5–20 (27) mm. long, the terminal one usually longer than the adjacent pair; *peduncles* incurved-ascending, 3–9 cm. long; *racemes* loosely 3–12-flowered, the axis somewhat elongating, 1–6 cm. long in fruit; bracts membranous, ovate, acute, 1–1.5 mm. long; *pedicels* at anthesis 1–1.5 mm. long, in fruit ± arched outward, somewhat thickened, 2–3 mm. long; *bracteoles* 0–2; *calyx* 5.5–6.8 mm. long, strigulose with black sometimes mixed with a few longer white hairs, the disc 1–1.2 mm. deep, the campanulate tube 3.5–4.5 mm. long, 3–3.8 mm. in diameter, the subulate or triangular teeth 2–2.7 mm. long; *petals* ochroleucous, the banner often tinged and veined with lilac; *banner* 11.5–12 mm. long, the short-cuneate claw abruptly expanded into an ovate or subcircular, emarginate blade 8–9 mm. wide; *wings* 9.7–10.7 mm. long, the claws 4.5–5 mm., the obliquely oblong-obovate, obtuse or subtruncate blades 6–6.4 mm. long, 2.5–2.8 mm. wide; *keel* 9.2–10.4 mm. long, the claws 4.4–4.9 mm., the blades 5.5–6.6 mm. long, 3–3.2 mm. wide below the beak; *anthers* ± 0.6 mm. long; *pod* spreading or declined, subsessile or obscurely stipitate, the thick stipe 0.7–1.5 mm. long, concealed by the calyx, the body broadly and subsymmetrically ellipsoid, ovoid, or obovoid-ellipsoid, bladdery-inflated, 2.5–4 cm. long, 1.2–2 cm. in diameter, rounded at base, rounded or cuneate at apex but scarcely beaked, terete or somewhat dorsiventrally compressed and then very shallowly and openly sulcate ventrally, the stiffly papery, ultimately lustrous valves stramineous or brownish speckled with purplish-brown on the side exposed to the sun, densely strigulose; *ovules* 26–33; *seeds* reddish-brown, somewhat pitted, dull, 3.1–3.5 mm. long.—Collections: 8 (i); representative: *Clokey 7172* (NA, NY, RSA, UC, WS), *7173* (NA, NY, RSA, UC, WS); *Train 1997* (NA, NY).

Calcareous gravel flats and open ridges, often sheltering under low sagebrush, with piñon and Utah juniper, ascending into the lower edge of the yellow pine forest, 6000–8200 feet, locally plentiful but known only from the east and northeast slopes of the Charleston Mountains, Clark County, Nevada.—Map No. 25.—April to June.

Astragalus aequalis (equal, of the pod's subsymmetrically convex sutures) Clokey in Madroño 6: 215. 1942.—"Charleston Mountains, Clark County, Nevada: Harris Springs road ... June 4, 1937, *Clokey 7572* (type) ..."—Holotypus, UC! isotypi, G, GH, K, MINN, MO, NA, NY, OB, PH, RM, RSA, SMU, TEX, WIS, WS!

The Clokey milk-vetch, *A. aequalis,* was described as related to the cismontane Californian *A. (Inflati) Douglasii,* from which it differs importantly in its substipitate, persistent pod. Inflation of the fruit has occurred independently in several phylogenetic lines within the genus


N
24

and is no sure indication of relationship taken out of the context of other characters. This fact becomes particularly clear when *A. aequalis* and *A. pinonis* are carefully compared. For they are almost identical in growth-habit, stipules, foliage, and fine detail of the floral parts, and differ only slightly in flower-size and ovule-number apart from the conspicuous disparity in the pod's girth. Both species occur on limestone bedrock, in similar habitats, and in environments typical of the Great Basin ranges. In the setting of its section *A. aequalis* is clearly the more recently derived and more highly specialized form.

Although not described until 1942, *A. aequalis* was first collected in 1898 by C. A. Purpus (*No. 6113,* UC). The Purpus specimens were examined by Jones, but passed over as representing the technically very different and allopatric *A. (Inflati) allochrous.*

XII (iv). Subsectio Lancearii

Sparsely leafy or apparently leafless and ephedroid or junceous, the lateral leaflets of nearly all (or all) leaves few, small, and scattered, or wanting, the terminal one continuous with the rachis; *flowers* rather small, ascending at full anthesis, the banner 8.5–15.5 mm. long, gently recurved through ± 45°; *keel-tip* obtuse or barely subacute, never beaklike; *pod* deflexed or pendulous, sessile or stipitate, lance-oblong to linear or linear-oblanceolate in profile, ± 2–4 cm. long, variably compressed; *ovules* mostly 16–31, in 2 rare spp. 8–14.—Spp. 5, of the Colorado and Uintah Basins, extending west into southwestern Utah and adjoining Arizona.

Astrgalus sect. Lonchocarpi subsect. Lancearii, subsect. nov., floribus mediocribus parvisve ad anthesin adscendentibus, carinae apice obtuso, legumine saepius subsessili vel arcte sessili (apud *A. nidularium* et *A. Harrisonii* transitum in *Lonchocarpos* genuinos praebentes stipitato) ab aliis sectionis sejungendi.—Plantae parce foliosae vel subaphyllae junceae, foliolis terminali fere semper decurrenti lateralibus saltem foliorum summorum multo reductis vel obsoletis.—Sp. typica: *A. lancearius* Gray.

The *Lancearii* are held together by habital and floral similarities which can only be interpreted as conclusive evidence of close kinship, but they are quite heterogeneous as regards the pod. The sessile, laterally flattened, bladelike fruit of *A. lancearius* and *A. Episcopus* is quite like that of subsect. *Pseudogenistoidei,* whereas the stipitate, dorsiventrally compressed fruit of *A. nidularius* and *A. Harrisonii* is almost a perfect match for that of *A. Schmollae* of the genuine *Lonchocarpi.* The pod of *A. duchesnensis* is neatly intermediate in form, being subsessile, dorsally flattened in the lower half and laterally compressed upward.

Key to the Species of Subsect. Lancearii

1. Pod sessile or nearly so, the stipe not over 1 mm. long, the body variably compressed, but dorsiventrally so only in *A. duchesnensis* of the Uintah Basin (2)
   2. Pod ± strongly compressed laterally its whole length, the dorsal suture as prominent toward the base as distally; s. of Tavaputs Escarpment in Utah, to n. Arizona (3)
      3. Calyx 5.3–8.5 (9) mm. long, the deeply campanulate or subcylindric tube (3.8) 4.2–6.2 mm. long, 1.9–2.8 mm. in diameter, the teeth (1) 1.2–3 mm. long; *keel* ± 9–12 mm. long; *ovules* 16–26; s.-e. Utah and n. Arizona ..... 57. *A. Episcopus*
      3. Calyx 3.8–4.8 mm. long, the campanulate tube 3–3.5 mm. long, 2.2–2.6 mm. in diameter, the teeth 0.7–1.3 mm. long; *keel* ± 8–8.5 mm. long; *ovules* 8–14; s.-w. Utah and adjoining n.-w. Arizona ..... 58. *A. lancearius*
   2. Pod dorsiventrally compressed in the lower half, laterally compressed distally, hence the dorsal suture depressed proximally; Uinta Basin, Utah ..... 59. *A. duchesnensis*
1. Pod stipitate, the stipe 3–6 mm. long, the body ± obcompressed, flattened or shallowly grooved dorsally; s.-e. Utah (4)
   4. Stems 1.5–3.5 dm. long, greenish-cinereous, strigulose; *leaves* mostly pinnate; *racemes* mostly 8–33-flowered, the axis 4–20 cm. long in fruit; *calyx* (3.8) 4.8–7 mm. long, the tube (3.3) 4–5.2 mm. long; *anthers* 0.65–0.9 mm. long; *body* of the pod 2–3.2 cm. long, 3.5–4.5 mm. in diameter; *ovules* 20–24; San Juan County (White Canyon) ..... 60. *A. nidularius*

Map No. 24. Utah and northern Arizona. Range of ◆ *A. Episcopus*; of ◊ *A. lancearius*; of ◖ *A. duchesnensis*; of ◢ *A. nidularius*; of ◡ *A. Harrisonii*; and of ◠ *A. Cronquistii.*

4. Stems 4–7 dm. long, green, subglabrous; *leaves* all but the lowest reduced to the rachis; *racemes* 4–12-flowered, the axis greatly elongating and 1–4 dm. long in fruit; *calyx* 2.7–3.4 mm. long, the tube 1.5–2.9 mm. long; *anthers* 0.5 mm. long; *body* of the pod 1.7–2.1 cm. long, 3–3.4 mm. in diameter; *ovules* 10–12; Wayne County (Capitol Reef) ..... 61. *A. Harrisonii*

57. Astragalus Episcopus

Stiffly wiry, apparently leafless, strigulose throughout with appressed, filiform or somewhat flattened hairs up to 0.45–0.75 mm. long, the stems and herbage green or yellowish-green, the growing tips often cinereous, the leaflets (when present) pubescent on both sides, sometimes more densely so above than beneath; *stems* few or solitary from a woody taproot or shortly forking caudex, simple and subterranean for a space of 2–9 (12) cm., on emergence stouter and purple-tinged, divaricately branched at the lower exposed nodes, the branches often disposed in unequal pairs in the lower axils and the more vigorous ones again branched or spurred up to the first peduncle, the internodes flexuous or abruptly zigzag; *stipules* dimorphic, those at the buried (and often at the first emersed) nodes papery, ovate or oblong, obtuse or subobtuse, several-nerved, 2–13 mm. long, strongly adnate to the suppressed petiole to form a bidentate sheath but incompletely amplexicaul and free, the usually smaller, herbaceous upper ones deltoid or triangular-acuminate, semi- or less than semiamplexicaul, with erect or recurved blades; *leaves* ascending, divaricate, or deflexed, 2–10 cm. long, most (or all) of them reduced to the grooved rachis, a few (usually low on the stems) bearing 1–4 (6) remote, opposite or scattered, linear-elliptic and subacute or narrowly oblong and obtuse-emarginate, shortly petiolulate or decurrent, thick-textured, involute or folded lateral leaflets 1–15 mm. long; *peduncles* erect or incurved-ascending, 6–20 (23) cm. long, surpassing the leaf; *racemes* loosely or remotely (4) 6–22 (30)-flowered, the flowers ascending, the axis early elongating, 3–20 (27) cm. long in fruit; *bracts* either scarious or firm but then early becoming pallid, triangular or lanceolate, 1.3–3 mm. long; *pedicels* at anthesis straight, ascending, 1.5–3 mm. long, in fruit thickened, arched out- and downward, or contorted, or more abruptly dejected, but scarcely longer, *bracteoles* 0–2; *calyx* 5.3–8.5 (9) mm. long, white-strigulose, the subsymmetric disc (0.9) 1.2–2.2 mm. deep, the deeply campanulate to subcylindric tube (3.8) 4.2–6.2 mm. long, 1.9–2.8 (3.4) mm. in diameter, the broadly subulate to narrowly lanceolate teeth (1) 1.2–2.8 (3) mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish commonly pink-tinged, rarely purplish, the color fugacious, appearing ochroleucous or brownish in most specimens; *banner* recurved through ± 40–45°, rhombic-obovate or -elliptic, notched, 11–14.4 (15.5) mm. long, 5.8–9.4 mm. wide; *wings* nearly as long or up to 1.5 mm. shorter, 10–12.7 (14.3) mm. long, the claws 5–6.4 mm., the oblong-oblanceolate, -elliptic, or linear-oblong, obtuse or erose, almost straight blades 5.4–8 (8.9) mm. long, 1.2–2.7 (3.7) mm. wide; *keel* 9–12.3 mm. long, the claws 4.9–6.6 mm., the half-obovate blades 4.5–6 (6.6) mm. long, 2.1–2.7 (3.5) mm. wide, incurved through 80–95° to the rounded or exactly deltoid apex; *anthers* 0.5–0.65 (0.75) mm. long; *pod* deflexed, sessile or cuneately tapering at base into a stout stipelike neck up to 0.6 mm. long, oblong- to narrowly lance-elliptic in profile, commonly a trifle arched downward proximally and straight thereafter, (1.5) 3–3.2 cm. long, 4–7 (8) mm. in diameter, tapering and cuspidate at apex, ± strongly compressed and 2-sided but the lateral faces convex at maturity, bicarinate by the broad ventral and more slender dorsal sutures, the thinly fleshy, green or purple-tinged, glabrous or strigulose valves becoming stiffly papery, stramineous or brownish-purple, faintly reticulate (the nerves largely immersed), not inflexed; *ovules* 16–24 (26); *seeds* (little known) brown, pitted and wrinkled but sublus-

trous, ± 3–3.5 mm. long.—Collections: 19 (iii); representative: *Jones* (from San Rafael Swell), *May 11, 18, 19, 1915* (CAS, NY, POM, WS); *Holmgren et al. 7774* (ARIZ, BRY, CAS, NY, POM, UTC, WS); *Barneby 13,146* (CAS, NY, RSA); *Peebles & Parker 14,644* (CAS, GH, NY, US), *14,689* (ARIZ, US); *Ripley & Barneby 4856* (CAS, RSA); *Cutler 3141* (MO, NY, US).

Barren sandy or sandy clay knolls, bluffs, and rocky talus beneath escarpments, on sandstone or in petrified forest, 4200–5200 feet, locally plentiful but apparently of bicentric dispersal: common in the San Rafael Swell and Wayne Wonderland, south to the foothills of the Henry Mountains in Emery, Wayne, and Garfield Counties, Utah; also on the Colorado River and its tributaries in Coconino and extreme northeastern Mohave Counties, from Marble Canyon west to Kanab Creek (Pipe Springs; Fredonia), south to Moenkopi Wash and the Little Colorado at Wupatki National Mounment.—Map No. 24.—May and June.

ASTRAGALUS EPISCOPUS (a bishop, a tribute to the collector) Wats. in Proc. Amer. Acad. 10: 345. 1875 *("episcopus").*—"Southern Utah, Capt. F. M. Bishop."—Holotypus, GH! isotypi, NY, PH, US (some mixed with *A. Coltoni* and perhaps other spp.)—*Tragacantha Episcopus* (Wats.) O. Kze., Rev. Gen. 944. 1891 *("episcopa"). Homalobus Episcopus* (Wats.) Rydb. in Bull. Torr. Club 40: 53. 1913.

Astragalus kaibensis (of Kaibab Plateau, a misnomer) Jones, Contrib. West. Bot. 10: 64. 1902 *("Kaibensis").*—"... at House Rock, near Lee's Ferry, northern Arizona, June 18, 1890." —Holotypus (3 sheets), POM! isotypus (fragm.), NY!—*Lonchophaca kaibensis* (Jones) Rydb. in N. Amer. Fl. 24: 314. 1929.

The Bishop milk-vetch is one of several superficially similar ephedroid astragali native to the Colorado Basin, but it is likely to be confused only with related *Lonchocarpi,* for these alone have similar pods combined with free lower stipules. The differential characters of *A. lancearius* have been stressed already in the key to subsect. *Lancearii; A. xiphoides* is distinguished by its more shortly campanulate calyx-tube and shorter, little or irregularly graduated petals, all about 8–9 mm. long and all very strongly recurved.

On the San Rafael and Fremont Rivers in Utah *A. Episcopus* is locally abundant and rather common, but in northern Arizona the known stations are few and far apart and the populations seem to be small in extent and numbers. There is no record of the species from between the mouth of the Paria and the Henry Mountains, a gap of over a hundred miles, but there seem to be no tangible differences between the plants in the two segments of the range. In Utah the pod is perhaps slightly thinner in texture when fully ripe and tends to be a little more strongly flattened laterally. The habit of growth and the flower remain essentially stable, granted a range of variation normal in any species at all widely dispersed. Jones referred the Utah material to *A. lancearius* and divided the Arizona material available up to 1923 between *A. Episcopus* and *A. kaibensis,* but I have come to the belief that the latter is nothing more than a minor variant of the Bishop milk-vetch. Jones and Rydberg knew *A. kaibensis* only from the type-collection, which consists of immature specimens. The pod was thought by Jones to be subterete or even a little grooved ventrally; his figure (1923, Pl. 64) shows the cross-section as almost circular. Riper specimens from House Rock Valley collected in recent years (e.g., *Peebles & Parker 14,644; Ripley & Barneby 4856,* cited above) show that the fruit in this region is indeed a little turgid, with low-convex lateral faces and an oval-elliptic section, but the sutures are both prominent and the pod could only be described as laterally compressed. Southward, on the Little Colorado (50 miles s. of Lee's Ferry, *Jones,* POM; Wupatki National Monument, *David Jones 345,* ARIZ, US), the pod is once again strongly flattened and except for its slightly stiffer texture identical with that of the Utah plant.

The history of *A. Episcopus* is quickly told. The species was collected first in 1872, when Capt. Bishop was with the Powell Grand Canyon Expedition and working out of Kanab. Jones surmised that the type-locality was "probably on the western side of the Kaibab south of Kanab," and modern collections from the Fredonia-Pipe Springs area lend some support to this view. The material of *A. Episcopus* distributed under that name by Watson was a mixture, containing at least some fruits and probably some flowers of *A. Coltoni.* The latter is endemic to Utah and is there partly sympatric with *A. Episcopus;* the type-material may therefore have come from the general region of the Henry Mountains or even farther north. However this may be, the original mixture gave rise to considerable confusion in the past. Rydberg, basing his opinion on the isotypus at NY, transferred the name to *A. Coltoni* (cf. Rydberg, 1923, p. 185) and subsequently (1947, p. 33) I proposed that *A. Episcopus* should be discarded as a nomen ambiguum because it was based on several discordant elements. At the time of this

proposal I lacked insight into the taxonomic problems posed by *A. lancearius* and its close kin, and I also failed to appreciate the fact that the holotypus of *A. Episcopus* (the material retained by Watson at GH) is entirely of the species under discussion here. It is now felt that the name can properly be salvaged for its present purpose. Confusion between *A. Episcopus* and *A. lancearius* is analyzed further under the next species.

58. Astragalus lancearius

Wiry, sparsely leafy or almost leafless, closely resembling *A. Episcopus* in habit of growth, strigulose with filiform or somewhat flattened hairs up to 0.35–0.5 mm. long, the stems greenish, the growing tips cinereous, the leaflets (when present) equally pubescent on both sides; *stems* few or solitary, 2–4.5 dm. long, erect or incurved-ascending, simple and subterranean for a space of 2.5–10 cm., stouter and purplish on emergence, divaricately branched up to the first peduncle, the branches either solitary or disposed in unequal pairs, or (upward) paired with a sterile spur or a peduncle, the more robust branches commonly again branched, the internodes flexuous or zigzag; *stipules* dimorphic, the papery lower ones up to 3–6 mm. long, adnate to the suppressed petiole, semi- or almost fully amplexicaul but free, the upper ones shorter, narrower, herbaceous, with deltoid-acuminate or triangular, erect or deflexed blades; *leaves* (2) 4–9.5 cm. long, most of them, sometimes all, the uppermost always, reduced to a naked rachis often a trifle expanded and hooked at apex, a few of them (usually the lowest) bearing 1–3 pairs of distant, opposite or scattered, firmly petiolulate, linear or linear-elliptic, obtuse or subacute, involute leaflets 2–14 mm. long; *peduncles* 4–17 cm. long, the lower ones stout, the upper slender or subfiliform, all surpassing the leaf; *racemes* loosely or remotely (6) 10–25-flowered, the axis elongating, (3) 5–26 cm. long in fruit; *bracts* thinly herbaceous becoming papery, ovate-triangular, 1–1.5 mm. long; *pedicels* at anthesis straight, ascending 1–2 mm. long, in fruit recurved or refracted, somewhat thickened, up to 3 mm. long; *bracteoles* minute or 0; *calyx* 3.8–4.8 mm. long, strigulose with white or mixed black and white hairs, the campanulate tube 3–3.5 mm. long, 2.2–2.6 in diameter, the deltoid or broadly triangular-subulate teeth 0.7–1.3 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish or faintly pink- or lilac-tinged; *banner* recurved through ± 45°, rhombic-elliptic, notched, 9.5–11.5 mm. long, 5.5–6 mm. wide; *wings* 9.3–10.2 mm. long, the claws 3.6–4.5 mm., the narrowly oblanceolate, obtuse, scarcely incurved blades 5.9–6.4 mm. long, ± 2 mm. wide; *keel* 7.7–8.4 mm. long, the claws 3.5–4.5 mm., the half-obovate blades 4.2–4.8 mm. long, 2.1–2.6 mm. wide, incurved through 90–95° to the obtuse apex; *anthers* 0.5–0.65 mm. long; *pod* deflexed, sessile or almost so, narrowly or sometimes broadly lanceolate to lance-oblong or linear-elliptic in profile, either nearly straight and subsymmetrically cuneate or cuneate-acuminate at both ends, or gently arched downward and the dorsal suture then straight to slightly concave and the ventral one strongly convex, the whole 2–3.4 cm. long, 5–7 (9) mm. in diameter, very strongly compressed, with nearly flat sides and salient sutures, the thin, pale green, glabrous or strigulose valves becoming stramineous, papery, lustrous, delicately reticulate, not inflexed; *ovules* 8–14; *seeds* (little known) brown, sometimes purple-dotted, pitted but ± lustrous, 3.5–3.8 mm. long.—Collections: 5 (i); representative: *Eastwood & Howell 9198* (CAS, RSA), *9323* (CAS); *Ripley & Barneby 4833* (RSA); *Jones 5291k* (POM).

Sandy clay flats and barren gravelly knolls and hillsides, on sandstone (and perhaps on limestone), 2000–5500 feet, rare and local, known only from the Virgin Valley in Washington County, Utah, and the Beaver Dam Mountains in adjoining Arizona, east to the canyon of the Paria in Kane County, Utah, and the north foothills of the Kaibab south of Kanab.—Map No. 24.—April to June.

Astragalus lancearius (a lancer, from the bladelike pod) Gray in Proc. Amer. Acad.

13: 370. 1878.—"Near Beaverdam on the Rio Virgen, northwest corner of Arizona, Dr. Palmer, 1877."—Holotypus, *Palmer 114 in 1877,* GH! isotypi, K, NY!—*Homalobus lancearius* (Gray) Rydb. in Bull. Torr. Club 40: 52. 1915.

The lancer milk-vetch, *A. lancearius,* is closely related to and presumably derived from the much commoner and better known *A. Episcopus,* and it could reasonably be reduced to varietal rank. The two species are virtually identical in habit of growth, and their pods are essentially alike in exterior form and structure. Nevertheless *A. lancearius* is easily distinguished by its shorter, differently proportioned calyx, and this alteration in the flower accompanied by an abrupt diminution in ovule-number from 8–13 to 4–7 pairs justifies its recognition as a species, at least pending discovery of intermediate forms. The pod of *A. lancearius* is of slightly thinner texture than that of *A. Episcopus* so that the reticulation of the ripe valves is elevated and conspicuous rather than largely or almost wholly immersed.

The species, poorly understood in the past, is still known from too few collections. Rydberg (1929, p. 257) thought it differed from *A. Episcopus* in its truly sessile rather than shortly stipitate pod, but this character no longer serves to divide the material into credible species. Jones (1923, p. 67) attributed to *A. lancearius* peduncles longer than the leaves and relatively long, subulate calyx-teeth in contrast to short peduncles and short, blunt teeth in *A. Episcopus.* The peduncles surpass the leaves in both species, and annotations (POM) show that Jones had transferred his concept of *A. lancearius* from the original plant of the Beaver Dam Mountains to one which he collected in quantity in the San Rafael Swell during the summer of 1915. The latter is our *A. Episcopus,* and it is clear that Jones had lost sight of the genuine and much rarer *A. lancearius,* of which he possessed very little material. Encountering the problem several years ago, (1947, p. 32) I naively misinterpreted the differences in the flowers of *A. lancearius* and *A. Episcopus* as examples of random variation and overlooked the important ovule-character. I was not only misled by Jones but also influenced by having collected typical *A. lancearius* near Kanab, Utah, which I believed to be the type-locality (although this is quite uncertain) of *A. Episcopus.* It seemed improbable in the extreme that two species so much alike could grow together. I now know, however, that genuine *A. Episcopus* does extend west as far as Pipe Springs in the valley of Kanab Creek, whereas *A. lancearius* has been traced east along the Zion Escarpment as far as the Paria Canyon in Utah and the Buckskin Mountains (Jones's term for the north foothills of the Kaibab) in Arizona. The ranges of the two species apparently overlap slightly but there is yet no sign of intergradient populations.

The few collections of *A. lancearius* now available for study suggest that racial differentiation is still active in the species. In the Virgin Valley the pod is glabrous and symmetrically lanceolate, with both sutures equally convex. East of Zion the almost always strigulose pod varies in profile from straight and subsymmetric to definitely decurved and thus strongly asymmetric in profile, with straight or even slightly concave dorsal and strongly bowed ventral sutures. In the related *A. Episcopus* the pod is known to vary from glabrous to strigulose within the limits of a small and obviously monophyletic population.

The epithet *lancearius* was misspelled *"lancelarius"* in Rydberg's *Flora of the Rocky Mountains,* and the incorrect version has attained a spurious vitality by use in herbaria.

59. Astragalus duchesnensis

Wiry, sparsely leafy, strigulose throughout or nearly so with fine, straight, appressed (sometimes a few narrowly ascending) hairs up to 0.3–0.55 mm. long, the stems and herbage greenish or cinereous, the leaflets either pubescent on both sides or commonly glabrescent above; *stems* few or several, sometimes solitary, erect and ascending in clumps or sometimes diffuse and straggling, 1.5–3.5 dm. long, subterranean for a space of 1.5–6 cm., leafless and purple-tinged toward the base, branched or spurred at 1–5 nodes preceding the first peduncle, the branches sometimes again branched, becoming zigzag distally; *stipules* dimorphic, the lowest ones ovate-oblong, papery-membranous, pallid or brownish, several-nerved, 3–8 mm. long, adnate to the vestigial petiole and amplexicaul-decurrent around ¾ to the whole stem's circumference, free, the median and upper ones smaller, triangular or triangular-acuminate, the firm, green or purplish blades erect or recurved; *leaves* (1.5) 2.5–9.5 cm. long, shortly petioled, with 7–11 (15) rather distant, linear, linear-filiform, or (in some lower leaves) narrowly oblanceolate, obtuse or retuse, involute or rarely flat, petiolulate leaflets 3–20 mm. long, but the leaflets of the uppermost leaves often reduced in size, or number, or absent, the terminal one

represented by a scarcely expanded, often falcate blade continuous with the rachis; *peduncles* erect or incurved-ascending, (3) 4–9.5 cm. long; *racemes* loosely (3) 6–18 (22)-flowered, the axis becoming (1) 2.5–12 cm. long in fruit; *bracts* papery or early becoming so, triangular-ovate or lance-acuminate, 0.7–2 mm. long; *pedicels* at anthesis straight, ascending, 0.8–1.4 mm. long, in fruit arched outward or abruptly downward, thickened, 1–2.2 mm. long; *bracteoles* 0; *calyx* 3.6–5 mm. long, strigulose with black or mixed black and white hairs, the oblique or symmetric disc 0.7–1.2 mm. deep, the campanulate, often purplish tube 3.1–4.3 mm. long, 2.3–2.9 mm. in diameter, the broadly triangular-subulate or deltoid teeth 0.4–1 mm. long; *petals* bicolored, the pale-eyed banner and keel reddish-pink or -purple, the wings white; *banner* ovate-cuneate, shallowly emarginate, 8.5–12.4 mm. long, 5.2–7.8 mm. wide; *wings* (about as long or a trifle longer) 8.4–12.5 mm. long, the claws 4–5.2 mm., the oblong-oblanceolate, obtuse, slightly incurved blades 5–8.6 mm. long, 1.8–2.8 mm. wide; *keel* 8–9.8 mm. long, the claws 3.6–4.8 mm., the half-obovate blades 4.5–5.9 mm. long, 2.4–3.1 mm. wide, incurved through 90–95° to the broadly deltoid, obtuse apex; *anthers* 0.4–0.75 mm. long; *pod* deflexed, sessile or attenuate at base into a thick, glabrous, stipelike neck up to 1 mm. long, the body linear or commonly linear-oblanceolate in profile, 2–3.5 cm. long, 3.3–5.3 mm. in diameter, straight or more often gently arched downward in the lower ⅓ and straight or nearly so thereafter, tapering into the narrow base, triangular-cuspidate at apex, dorsiventrally compressed in the lower ½ and there obscurely trigonous, with flattened or openly and shallowly grooved dorsal and low-convex lateral faces, becoming ± laterally compressed and 2-sided distally, carinate ventrally by the prominent suture, the thinly fleshy, pale green or purplish, densely strigulose valves becoming stiffly papery and stramineous; *ovules* 21–31; *seeds* olivaceous or drab, closely pitted, 2.1–3 mm. long.—Collections: 12 (v); representative: *Ripley & Barneby 8714* (CAS, RSA, UTC); *W. A. Weber 5313* (COLO, RSA); *Rollins 1743* (NY); *Barneby 12,706* (CAS, NY, RSA).

Desert flats, hillsides, badlands, dunes, and sandy pockets about rock outcrops, on sandstone, 4800–5100 feet, locally plentiful on the floor of the central Uinta Basin, from the lower Duchesne River east to Dinosaur National Monument and to the White River a few miles west of the Colorado State line, in Uintah and adjoining Duchesne Counties, Utah.—Map No. 24 (some stations after Graham, 1937, p. 247).—Late April to June.

ASTRAGALUS DUCHESNENSIS (of Duchesne River or County) Jones, Contrib. West. Bot. 13: 6. 1910 *("Duchesnensis").*—"... from 13 miles below Theodore Utah to Chepeta Well and White River near the Colorado line..."—Lectotypus, collected at Chepeta Well, "6000 ft.," May 23, 1908, *Jones,* POM (3 sheets, marked "type" in Jones's hand).—Paratypi, collected by Jones between Theodore and Myton, 5000 ft., May 19, 1908, CAS, DS, NY (2 sheets), POM (5 sheets), RM, US!—*Lonchophaca duchesnensis* (Jones) Rydb. in N. Amer. Fl. 24: 313. 1929.

The Duchesne milk-vetch is a thinly leafy plant, but hardly junceous, since the foliage is better developed than in most other *Lancearii,* with only some uppermost leaves reduced (or nearly so) to the naked rachis. The ascending, bicolored flowers, unusual for the reddish, distinctly vinous tint of the banner and keel, and the curiously compressed fruits are distinctive. The known area of dispersal extends not more than thirty-five miles east and west over the floor of the Uintah Basin, but the species is not uncommon in its region. The plants occur in colonies and in favorable years form bold clumps of stems, especially vigorous on sands of the red beds but equally common on the whitish or tawny sand-clays of the badlands; however in dry years a formerly flourishing colony may yield only a few straggling wisps of stem, sterile or nearly so.

According to Jones's last account (1923, p. 251, Pl. 64) the pod of *A. duchesnensis* may reach a length of 6 cm. and a width of 7 mm., substantially larger than anything found in the Jones herbarium or in any other collection studied.

60. Astragalus nidularius

Slender, wiry, sparsely leafy, strigulose nearly throughout with fine, straight, appressed hairs up to 0.4–0.6 mm. long, the stems and herbage greenish-cinereous, the leaflets pubescent on both sides, commonly a trifle more densely so above than beneath; *stems* solitary or few together, 1.5–3 (3.5) dm. long, simple, naked and subterranean for a space of 4–16 cm., becoming stouter and divaricately branched upward from the first emersed node, the branches again forked or spurred and all incurved-ascending, together forming low, loosely entangled plants of bushy outline, the ultimate branchlets and leaf-stalks filiform; *stipules* 1.5–6 mm. long, dimorphic, the lowest ovate or broader than long, papery, pallid to brownish or purple-tinged, united to the vestigial petiole to form a semi- to fully amplexicaul-decurrent sheath, the upper ones mostly smaller, herbaceous, triangular-ovate or ovate-acuminate, with spreading or recurved blades; *leaves* 1.5–4.5 (6) cm. long, shortly petioled or subsessile, with 5–9 (11) distant, linear, linear-lanceolate, or -oblanceolate, obtuse or emarginate, mostly involute leaflets 2–13 mm. long, those of the lower leaves all jointed, but the terminal one of the reduced upper leaves continuous with the rachis; *peduncles* erect or incurved-ascending, 4–11 cm. long, much surpassing the leaf; *racemes* very loosely or remotely 8–33 (or some depauperate distal ones only 3–7)-flowered, the axis a little elongating, (1.5) 4–17 (20) cm. long in fruit; *bracts* herbaceous, triangular-ovate or broadly lanceolate, 1.2–2.2 mm. long; *pedicels* at anthesis straight, ascending, 1.2–2.5 mm. long, in fruit arched out- and downward, or abruptly deflexed, a little thickened, 1.5–3 mm. long; *bracteoles* 0–2, minute and setaceous when present; *calyx* (3.8) 4.7–7 mm. long, rather loosely strigulose with black and rarely a few white hairs, the subsymmetric disc 1.1–1.5 mm. deep, the campanulate or turbinate-campanulate tube (3.3) 4–5.2 mm. long, (2.2) 2.7–3.1 mm. in diameter, the subulate teeth (0.5) 0.8–2 (2.2) mm. long, the ventral pair commonly shortest; *petals* purplish-pink, drying bluish, the claws paler or almost white; *banner* rhombic-obovate, openly notched, (9.2) 11.2–14 mm. long, (6) 7.4–9 mm. wide; *wings* (8.1) 10–13.2 mm. long, the claws (3.5) 3.9–5.1 mm., the broadly oblanceolate, obtuse or obscurely erose-emarginate, slightly incurved blades (5.7) 7.1–8 mm. long, (2.1) 2.8–3.5 mm. wide; *keel* (7.5) 8.4–10.3 mm. long, the claws (3.5) 3.8–5.3 mm., the half-obovate blades 4.4–5.9 mm. long, (2) 2.5–2.9 mm. wide, abruptly incurved through 90–95° to the deltoid apex; *anthers* 0.65–0.9 mm. long; *pod* pendulous, stipitate, the straight stipe (3.5) 4–6 mm. long, the body linear-oblong or -oblanceolate in profile, straight or gently decurved, 2–3.2 cm. long, 3.5–4.5 mm. in diameter, cuneately contracted at base into the stipe and at apex into a very short, triangular-acuminate beak, dorsiventrally compressed, obtusely carinate ventrally by the thick suture, the lateral angles rounded, the dorsal face flattened or openly and shallowly sulcate, the thinly fleshy, green or purple-tinged, strigulose valves becoming stiffly papery, brownish-stramineous, finely cross-reticulate; *ovules* 20–24; *seeds* not seen ripe.—Collections: 3 (iii); representative: *Barneby 12,781* (CAS, NY, RSA), 13,079 (BRY, CAS, NY, RSA, US).

Canyon benches, in red clay soil derived from sandstone, with piñon and juniper, 5750–5800 feet, known only from the upper end of White Canyon, on the west slope of the Abajo Mountains, San Juan County, Utah.—Map No. 24.—May and June.

Astragalus nidularius (like a bird's nest, from the many incurved and entangled branches and branchlets) Barneby in Leafl. West. Bot. 8: 16. 1956.—"Utah: . . . near the head of White Canyon, 2 miles below the Kachina Bridge of Natural Bridges National Monument, 19 May, 1955, *R. C. Barneby No. 12,778* . . ."—Holotypus, CAS! isotypi, GH, K, NY, POM, UTC, RM, US, WS, WTU!

The bird's nest milk-vetch, *A. nidularius,* combines the wiry, sparsely leafy, freely branching growth-habit of *A. Episcopus* with a long-stipitate pod which resembles that of *A. Schmollae* of the following subsection in its form and gentle downward curvature. On account of its ephedroid appearance, combined with flowers of a lively pink shade, it might be confused at anthesis with *A. Coltoni,* but this has nodding flowers, a glabrous ovary, and ultimately a laterally flattened, two-sided pod. The differential characters of the more closely related *A. Harrisonii* have been brought out already in the key. Herbarium specimens cannot do justice to the delicate beauty of *A. nidularius* as seen growing on the red clay canyon benches along the road down from the Natural Bridges toward Hite's Ferry; there the plants are locally common in juniper-piñon woodland, associated with *Penstemon utahensis* Eastw. and *Erigeron argentatus* Gray. Although the main stems are always few and often solitary, they branch so freely and repeatedly that they form, together with the stemlike leaf-stalks, elaborate tangles of bushy outline, liberally beset with airy spikes of blossom.

61. Astragalus Harrisonii

Very slender, sparsely leafy or apparently leafless, with a stout taproot and subterranean root-crown or caudex, thinly strigulose with appressed or subappressed hairs up to 0.3–0.5 mm. long, the stems, leaf-stalks and peduncles green, the few leaflets pubescent on both sides, often a little more densely so above than beneath; *stems* numerous, 4–7 dm. long, subterranean for a space of 4–9 cm., upon emergence purple-tinged, branched at almost every node up to the first peduncle, the very slender branches, leaf-rachises and elongate peduncles all similar in form, the whole appearing as a low bushy clump of ephedroid but very slender stems; *stipules* 1–5 mm. long, dimorphic, the relatively large lower ones membranous becoming papery, pallid or brownish, ultimately fragile, united on the side corresponding with the suppressed petiole, semi- or almost fully amplexicaul, free, the small upper ones herbaceous, deltoid or triangular; *leaves* 1.5–4.5 cm. long, with slender, tapering rachis, the lowest petioled and with 1–3 pairs of distant, narrowly oblong-elliptic, subacute or obtuse, ± folded leaflets up to 9 mm. long, the remainder reduced to the rachis, this commonly a little dilated and in- or decurved distally; *peduncles* incurved-ascending, 6–15 cm. long, greatly surpassing the leaf; *racemes* remotely (2) 4–12 (15)-flowered, the flowers ascending at anthesis, declined in age, the axis greatly elongating, (0.5) 1–4 dm. long in fruit, the pods remotely secund; *bracts* firm, with membranous margin, deltoid or triangular-subulate, 0.5–1.1 mm. long; *pedicels* at anthesis slender, ascending, 1.5–2.8 mm., in fruit thickened, divaricate or abruptly refracted, 2.5–5.5 mm. long; *bracteoles* 0; *calyx* 2.7–3.4 mm. long, strigulose with white and a few black hairs, the disc 0.7–0.9 mm. deep, the campanulate tube 1.5–2.9 mm. long, 1.7–1.8 mm. in diameter, the triangular-subulate teeth 0.5 mm. long, the whole becoming papery, marcescent unruptured; *petals* pale purple; *banner* recurved through ± 50°, broadly ovate-cuneate, openly notched, ± 8.7 mm. long, 5.6 mm. wide; *wings* 7.7 mm. long, the claws 3.6 mm., the narrowly oblanceolate, obliquely emarginate, very slightly incurved blades 5 mm. long, 1.5 mm. wide; *keel* 7.4 mm. long, the claws 3.6 mm., the obliquely half-elliptic blades 4.1 mm. long, 2.1 mm. wide, incurved through ± 105° to the bluntly deltoid apex; *anthers* 0.5 mm. long; *pod* pendulous, stipitate, the stipe 3–4 mm. long, the body linear-ellipsoid, straight or very slightly decurved near the base and straight thereafter, 1.7–2.8 cm. long, 3–3.4 mm. in diameter, tapering at base into the stipe, abruptly contracted at apex into a short, purplish cusp, subterete when first formed, but obtusely carinate ventrally by the thick suture, flattened or slightly depressed dorsally, the thin, green, strigulose or subglabrous valves becoming papery, stramineous, cross-reticulate; *dehiscence* apical; *ovules* 10–12; *seeds* green, pitted or wrinkled, sublustrous, 3.5–5.5 mm. long.—Collections: 3 (i); representative: *B. F. Harrison 7393* (BRY); *Maguire 19,265* (RM, UTC) .

Sandy rock ledges and dunelike talus in canyons, ± 5700 feet, on sandstone,

known only from the type locality in Capitol Reef National Monument near Fruita, Wayne County, Utah.—Map No. 24.—Late April to early June.

ASTRAGALUS HARRISONII (Bertrand Fereday Harrison, 1908–), sp. nov., *A. nidulario* Barneby proxime affinis, habitu magis ephedroideo subaphyllo, pube brevissima sparsa, caulibus elatioribus viridibus, calyce, petalis antherisque brevioribus, legumine breviori et angustiori, ovulisque dimidio minus numerosis 10–12 nec 20–24 absimilis.—Elata pluricaulis minutim strigulosa, caulibus iteratim ramosis 4–7 dm., foliis 1.5–4.5 cm. longis, imis foliola 1–3-juga distantia parva gerentibus caeteris in rachin reductis, racemis remote (2) 4–12 (15)-floris, floribus parvulis, calyce 2.7–3.4 mm. longo, petalis purpurascentibus vexillo fere 9 mm. longo, legumine pendulo, stipitato lineari-ellipsoideo 1.7–2.8 cm. longo, 3–3.4 mm. diametro, sutura ventrali carinato, dorso applanato vel subdepresso, valvulis viridibus parce strigulosis demum chartaceis stramineis.—UTAH: wash below the Natural Bridge near Fruita, Wayne County, June 8, 1961, *R. C. Barneby 13,131*.—Holotypus, CAS! isotypi, BRY, GH, NY, RSA, RM, US!

The Harrison milk-vetch is closely related to *A. nidularius*, as shown by the essential similarities in the flower and pod, but the two species differ in many small characters which together affect the whole aspect of the plants and render them easily distinguishable. In general *A. Harrisonii* is taller, with longer, more slender internodes and fewer leaves bearing developed leaflets; it is also greener, because of the very sparse and short pubescence, and the more slenderly fusiform pods are also greener and more lustrous. The flowers of *A. Harrisonii* are smaller and paler, and although on the average fewer, they are strung out remote from one another along a substantially longer axis. Finally the ovules are only half as many, five to six rather than ten or twelve pairs. The habitat of the two species is rather different: *A. nidularius* is found on open benches among junipers, rooting in stiff red clay; *A. Harrisonii* is a plant of dunelike banks and loose sands on rock ledges, in the type-locality closely confined to white sandstone of the Navajo series.

XII (v). Subsectio LONCHOCARPI

Relatively robust and large-flowered, sparsely leafy, the leaves all imparipinnate, with narrow leaflets all jointed, or with only the terminal leaflet decurrent, or the leaflets of some upper (or all) leaves much reduced in size and number, or lacking; *flowers* nodding at full anthesis; *petals* (white, creamy, or pink-purple) moderately incurved, the banner (12–24 mm. long) through ± 35–50°, the keel-tip sharply or bluntly deltoid; *calyx-tube* deeply campanulate or cylindric; *pod* long-stipitate, the body linear-oblanceolate to narrowly oblong or narrowly elliptic in outline, variably compressed, ± 2–4.5 cm. long; *ovules* (12) 14–26.—Spp. 5, one *(A. lonchocarpus)* dispersed over the whole range of the section, one of the Colorado Basin, one of the Uinta Basin, two very local in southwestern Colorado and northern New Mexico.

ASTRAGALUS sect. LONCHOCARPI Gray in Proc. Amer. Acad. 6: 219. 1864.—Sp. typica: *A. lonchocarpus* Torr.—*Astragalus* sect. *Clavocarpus* Sheld in Minn. Bot. Stud. 1: 132. 1894, a superfluous substitute.

Homalobus sect. *Macrocarpi* Rydb., Fl. Rocky Mts. 509, in clave. 1917.—Sp. typica: *H. macrocarpus* (Gray) Rydb. = *A. lonchocarpus* Torr.

Lonchophaca Rydb. in N. Amer. Fl. 24: 312. 1929 & in Amer. Jour. Bot. 16: 198, Pl. XVK. 1929.—Generitypus: *L. macrocarpa* (Gray) Rydb. = *A. lonchocarpus* Torr.—*Astragalus* subgen. *Lonchophaca* (Rydb.) Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 203. 1941.

Key to the Species of Subsect. Lonchocarpi

1. Petals purple; *pod* laterally compressed, glabrous; Colorado Basin and Sevier Valley ..... 62. *A. Coltoni*
1. Petals white, cream-colored, or lemon-yellow; *pod* dorsiventrally compressed, or if laterally so (as in *A. Ripleyi* of the upper Rio Grande Valley) then ovary and pod strigulose (2)
   2. Leaflets 11–21, present and well-developed in all leaves, the terminal one continuous with the rachis only in *A. Ripleyi* (with laterally compressed pod); *ovary* and pod strigulose; highly localized spp. of s. Colorado and n. New Mexico (3)
      3. Leaflets glabrous above, the terminal one, at least in most leaves, continuous with the rachis; *pedicels* in fruit 3–7 mm. long; *pod* laterally compressed; n. Taos County, New Mexico, and adjoining Colorado ..... 63. *A. Ripleyi*

3. Leaflets pubescent on both sides, the terminal one jointed like the rest in all leaves; *pedicels* in fruit 2–2.5 mm. long; *pod* dorsiventrally compressed; Mesa Verde, s.-w. Colorado ..... 64. *A. Schmollae*

2. Leaflets 1–9 (11), those of the upper leaves, sometimes of all, greatly reduced in size or number, or sometimes wanting, the terminal one continuous with the rachis; *pod* dorsiventrally compressed, nearly always glabrous; widespread (4)

4. Leaflets, both terminal and lateral, linear-oblanceolate, linear, or filiform, none over 2.5 (3) mm. wide; *calyx-tube* cylindric or more rarely deeply campanulate, 2.7–4 mm. in diameter, the teeth 0.6–2 mm. long; *flowers* variable in size, the banner 13.5–19.5 mm., the keel 10.5–14 mm. long; widespread, but extending only rarely n. across Tavaputs Escarpment into the e. edge of the Uintah Basin ..... 65. *A. lonchocarpus*

4. Leaflets all oblanceolate or oblong-oblanceolate, the widest on a given plant 4–6.5 mm. wide; *calyx-tube* deeply campanulate, more tumid, 4–5.5 mm. in diameter, the teeth 1.7–2.6 mm. long; *flowers* a trifle larger, the banner 20–24 mm., the keel 13.7–16.6 mm. long; local on the floor of the Uintah Basin (near Vernal, Uintah County, Utah) ..... 66. *A. Hamiltoni*

62. Astragalus Coltoni

Variably but usually sparsely leafy, sometimes apparently leafless and junceous, strigulose with straight, appressed, filiform or somewhat flattened hairs, the herbage green or cinereous; *stems* arising from a subterranean root-crown (as typical of the section) or rarely (in var. *Coltoni*) from divisions of an aerial, eventually suffruticulose caudex, usually several or numerous, erect and ascending in clumps, 1–4 dm. long, naked and purplish at base, branched or spurred at base or at 1–3 nodes preceding the first peduncle, the branches sometimes disposed in unequal pairs (threes) to an axil, or (upward) inserted between a peduncle and its subtending leaf; *stipules* 1–7 mm. long, dimorphic, the lowest papery, pallid or brownish, approximate or sometimes imbricated, strongly adnate to a vestigial petiole to form a subtruncate or bidentate sheath, decurrent around ½ to the whole stem's circumference but free, the upper ones smaller, herbaceous, obscurely adnate, with deltoid or triangular-acuminate, often spreading or deflexed blades; *leaves* 2–10 cm. long, variable according to the var., either all imparipinnate, or all (or nearly all) reduced to the naked rachis; *peduncles* erect or strictly incurved-ascending, (4) 6.5–30 cm. long, the lowest 1–2 usually much longer and stouter than the rest and far surpassing the leaves, the racemes mostly projected well beyond the leafy part of the plant; *racemes* loosely (2) 5–30-flowered, the axis elongating, (1.5) 3–16 cm. long in fruit; *bracts* membranous, ovate or lanceolate, 0.5–3.2 mm. long; *pedicels* at first ascending, 0.8–1.5 mm. long, early arched outward or decurved, sometimes horizontally spreading, in fruit thickened, 1–2.5 mm. long; *bracteoles* 0, rarely a minute scale; *calyx* 4.5–8 mm. long, densely to quite thinly black-strigulose, the oblique disc 0.9–1.5 (1.8) mm. deep, the membranous, purplish, deeply campanulate or cylindric tube 4–6.7 mm. long, 2.3–3.7 mm. in diameter, the deltoid, triangular, or broadly subulate, often obtuse teeth 0.6–1.8 (2.3) mm. long, the ventral pair commonly shortest, the orifice strongly or little oblique; *petals* bright pink-purple, drying bluish, the wing-tips often paler; *banner* broadly rhombic-elliptic, -obovate, or broadly spatulate, notched or scarcely emarginate, 12–18.5 mm. long, (6) 6.5–12.5 mm. wide; *wings* as long or a little shorter, 11–18.3 mm. long, the claws 5.3–7.8 mm., the narrowly lanceolate, oblong-elliptic, or -oblanceolate, obtuse, subtruncate, or obliquely emarginate, straight or slightly incurved blades 8.6–11.8 mm. long, 2.3–3.5 mm. wide; *keel* 9–13 mm. long, the claws 4.9–7.4 mm., the half-obovate or lunately half-elliptic blades 4.6–6.6 mm. long, 2.3–3.5 mm. wide, incurved through 85–95° to the triangular-deltoid, sometimes slightly porrect and subacute apex; *anthers* (0.55) 0.6–0.9 (1) mm. long; *pod* pendulous, stipitate, the slender stipe

4–11 mm. long, the body oblong, linear-oblong, or -oblanceolate, 1.9–3.5 cm. long, (3) 3.5–6 mm. in diameter, straight or gently decurved, narrowly cuneate at base or tapering gradually downward into the stipe, cuneate-cuspidate at apex, strongly compressed laterally and 2-sided, bicarinate by the subfiliform but salient sutures, the faces low-convex, the somewhat fleshy, green or reddish, glabrous valves becoming stiffly papery, stramineous, almost smooth to faintly rugulose and cross-reticulate; *ovules* 14–20; *seeds* brown or olivaceous, sometimes purple-speckled, sparsely punctate, sublustrous, (2.9) 3.2–4.4 mm. long.

In the past the Colton milk-vetch has been aligned with *A. filipes,* which has a similarly compressed and stipitate pod, in *Homalobus* or the equivalent sect. *Homalobi.* Both Rydberg (1929, p. 272) and Jones (1923, p. 70) have described the stipules of *A. Coltoni* as connate, but this is not strictly correct. The lowest ones do form a bidentate, more or less amplexicaul sheath; however they are united not, as in *A. filipes,* by their contrapetiolar margins, but only by adherence to a vestigial petiole and thus have the structure and appearance characteristic of all genuine *Lonchocarpi.* Even though the pods of *A. Coltoni* and *A. filipes* are so much alike in outward form, their mode of dehiscence is somewhat different. In the *Lonchocarpi* dehiscence starts in the beak and proceeds downward through the ventral or both sutures, whereas the ripe pod of *A. filipes* and its close kindred splits open simultaneously through the beak and stipe. The close relationship of *A. Coltoni* to other *Lonchocarpi* only became truly apparent with the discovery of *A. Ripleyi,* a species easily mistaken for *A. lonchocarpus* except for its laterally compressed pod.

The species is extremely variable, especially in the development of the foliage, and consequently in gross aspect. The differences in flower-size, width of the pod, and position of the root-crown, once thought (Barneby, 1944, p. 49) sufficient to separate *A. canovirens* (= var. *moabensis*) from genuine *A. Coltoni* at the specific level, have failed to pass the tests of observation in the field and study of more material. The calyx and petals are now known to vary within nearly the same limits in both supposed species, the known extremes in both directions having been secured from populations of var. *Coltoni* in the type-region along the Price River. The average pod of var. *moabensis* is perhaps a little broader, but it varies considerably in length and girth. The position of the caudex depends, in the case of *A. Coltoni,* on environment of the individual plant. On rocky slopes or rock ledges the caudex is exposed, apparently more by weathering than by nature, and may become decidedly woody with lapse of time. But on hills of soft clay or on cobblestone bluffs, otherwise similar plants have the buried root-crown or caudex characteristic of var. *moabensis* and other members of the section. Typical var. *moabensis* is distinguished, unless depauperate, by having the proper stem longer in proportion to the more robust lower peduncles, and usually also by its more numerous and better-developed leaflets. However in San Juan and Grand Counties, Utah, and especially at low elevations in the trough of the Grand River, the terminal leaflet may vary from one plant to the next in a small group, now distinctly petiolulate and now clearly decurrent, but often separated from the rachis by a strangulation or a barely perceptible change in texture. Collections from the neighborhood of Cane Springs (e.g., *Barneby 12,757*), close to the probable type-locality of *A. canovirens,* are intermediate in all the critical characters, some individuals leaning toward var. *Coltoni* as ideally conceived, others closely approaching typical var. *moabensis.*

The pod of *A. Coltoni* is ordinarily unilocular as in most *Lonchocarpi,* but close examination occasionally reveals an incipient septum up to 0.5 mm. wide. The species is perhaps a loco-weed, for var. *moabensis* is reported toxic to swine.

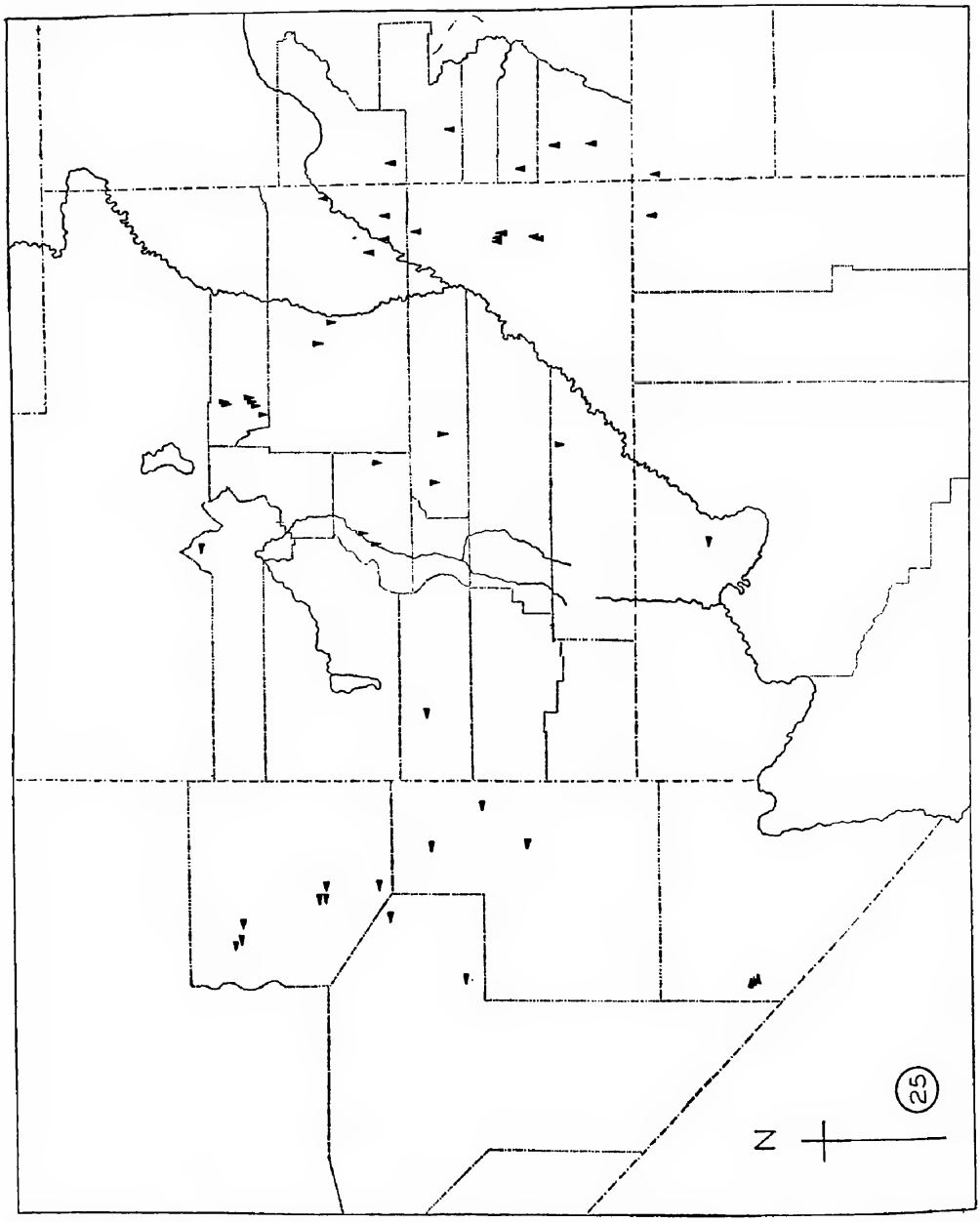
Key to the Varieties of A. Coltoni

1. Stems (1) 2–4 dm. long, long relative to the height of the whole plant, the first peduncle originating at a point (0.8) 1–3 dm. above the root-crown; *leaves* all imparipinnate, the lateral leaflets 8–18, the terminal one jointed in all leaves, sometimes obscurely so in the uppermost; Colorado Basin e. of the Green and Colorado Rivers in s.-e. Utah and adjoining states ..... a. var. *moabensis*

1. Stems 1–2.5 dm. long, short relative to the whole height of the plant, the first peduncle originating at a node 0.4–1 dm. above the root-crown; lateral *leaflets* 2–8 (10), mostly very distant and narrow, those of the upper leaves reduced in size or wanting, the terminal one continuous with the rachis; Colorado Basin w. of the Green River and middle Sevier Valley ..... b. var. *Coltoni*

62a. Astragalus Coltoni var. moabensis

Commonly more robust and more leafy than var. *Coltoni,* the stems arising always from a buried, knotty, or shortly forking root-crown, the stems and herbage strigulose with hairs up to (0.4) 0.5–0.8 mm. long, cinereous, greenish-cinereous, or canescent, the leaflets often bicolored, brighter green and usually less densely pubescent above than beneath; *leaves* (2) 3–9 cm. long, shortly petioled or the upper ones subsessile, with (5) 9–17 (19) oblong, cuneate-oblong, or a few ovate and flat, or in some upper leaves linear-oblong or -oblanceolate and involute, obtuse, truncate, or retuse leaflets (3) 5–20 mm. long, the terminal one



Map No. 25. Parts of Utah and adjoining states. Range of ◖ *A. pinonis*; of ◗ *A. aequalis*; and of *A. Coltoni*: ◥ var. *Coltoni*; and ◢ var. *moabensis*.

nearly always jointed like the rest, the joint obscure (lacking) only in a few upper leaves; *peduncles* (4) 6.5–21 cm. long; *racemes* (6) 10–30-flowered; *stipe* of the pod 5–11 mm. long, the body 1.9–3.5 cm. long, (3) 3.5–6 mm. in diameter. —Collections: 14 (v); representative: *Jones* (from La Sal Mountains) *in 1913* (CAS, NY, POM, US, WS); *B. F. Harrison 11,136* (RSA, US); *Ripley & Barneby 5362* (CAS, RSA); *Peebles & Smith 13,557* (CAS).

Dry hills, mesas and canyon terraces, commonly in juniper-piñon woodland, often associated with sagebrush, in sandy or gravelly soils derived from sandstone or in the valleys in rich alluvial clays, 4800–7000 (7500) feet, locally abundant in the foothills and on the lower slopes of the La Sal and Abajo Mountains in southeastern Utah and adjoining Colorado, extending more rarely south across the San Juan River to extreme northwestern New Mexico and northeastern Arizona; in the Moab region intergradient to var. *Coltoni*.—Map No. 25.—April to June.

ASTRAGALUS COLTONI var. MOABENSIS (of Moab, Utah) Jones, Contrib. West. Bot. 8: 11. 1898.—"Collected at Moab by Miss Eastwood and by myself at Green River, Utah."—No specimen with correct data found at CAS or POM, the only Eastwood material being her *No. 9 in 1892*, from Monticello, San Juan County, here selected as neotypus. The paratypus from Green River, wrongly labeled Greenriver, Wyoming (POM) is better referred to var. *Coltoni*.

Astragalus Coltoni var. *foliosus* (leafy) Jones ex Eastw. in Zoë 4: 115. 1893, nom. nud. —"Courthouse Wash near Moab."—This collection was apparently lost, at least not found either at CAS or POM where expected. The name was apparently a preliminary one, replaced by var. *moabensis*, q.v.

Homalobus canovirens (greenish-white, of the leaves) Rydb., Fl. Rocky Mts., Ed. 2. 1126. 1922.—"Utah, La Sal Mountains, *Rydberg & Garrett 8536*."—Holotypus, NY!—*Astragalus canovirens* (Rydb.) Barneby in Leafl. West. Bot. 4: 49. 1944.

The Moab milk-vetch is distinguished from var. *Coltoni*, with exceptions briefly mentioned in the introductory paragraphs, by its coarser, more leafy stems which rise farther from the ground before producing the first peduncle. And it seems to be adapted to less xerophytic microhabitats. The Four Corners country offers extensive areas of badlands and desertic talus where var. *Coltoni* might be expected to find a congenial home, but these situations are shunned by var. *moabensis* in favor of brushy slopes and sagebrush flats where the soil is richer and better watered.

An ambiguous specimen, apparently referable to var. *moabensis* but possibly deserving more attention, was collected ostensibly at Robertson, Uinta County, Wyoming, in June 1932, by R. C. Rollins (*No. 177*, RM, distributed as *Hedysarum* sp.). If correctly identified as *A. Coltoni*, it was probably mislabeled.

62b. ASTRAGALUS COLTONI var. COLTONI

Sparsely leafy, ephedroid or ± junceous, the numerous stems arising from the buried root-crown or (especially on rocky slopes) from an aerial, ultimately forking and suffruticulose caudex; *leaflets*, when present, either pubescent on both sides or glabrous above, greenish or cinereous; *leaves* 2–10 cm. long, the lowest ones petioled and bearing 1–5 distant pairs of linear, rarely linear-oblong, obtuse or subacute, flat or commonly involute leaflets 4–10 (14) mm. long, the terminal one confluent, the upper leaves, sometimes nearly all, reduced to a wiry or subfiliform rachis often expanded at tip into a linear phyllode representing the terminal leaflet; *peduncles* 1–3 dm. long; *racemes* (2) 5–20 flowered; *stipe* of the pod 4–9 mm. long, the body 2.5–3.2 cm. long, (3) 3.5-5.2 mm. in diameter.—Collections: 15 (v); representative: *Maguire 18,265* (UTC, WTU); *Ripley & Barneby 8691* (CAS, RSA); *Jones 5486* (MO, NY, POM); *Barneby 12,691* (CAS, NY, RSA).

Dry banks, gullied clay knolls, cobblestone bluffs, sometimes on sandy rock ledges or on boulder-strewn talus under cliffs, mostly 5500–6600, rarely up to 8000 feet, mostly on sandstone, locally plentiful along the west edge of the Colorado Basin from the upper Price River in Carbon County south to the Kaiparowits Plateau in Kane County, Utah; Sevier Valley in Sevier County.—Map No. 25.—April to June.

ASTRAGALUS COLTONI (W. F. Colton, "long identified with the region") Jones in Zoë 2: 237. 1891.—"... cañons of the Coal Range at Castle Gate, on the eastern side, on talus. Collected June 22, 1889, in fruit, and May 11, 1890, in flower."—Cotypi, POM! isotypi, GH (fl.)! NY, US (fr.)!—*Homalobus Coltoni* (Jones) Rydb. in Bull. Torr. Club 50: 269. 1923.

Astragalus Coltoni var. *aphyllus* (leafless) Jones, Rev. Astrag. 71, Pl. 1. 1923.—"Richfield, Utah, in the red sandstone cliffs."—Holotypus, collected by Jones, June 18, 1898, POM!

In dry springs and always with the advance of summer the Colton milk-vetch forms inconspicuous broomlike tufts of almost leafless stems not easily recognized as an astragalus. However in late April or May of favorable years, the plants erupt into a mass of pink-purple which rivals that of *Hedysarum boreale* Nutt. in richness of color and is quickly followed by strings of bladelike pods pendulous on thready stipes. In its area of dispersal it is the only ephedroid astragalus with bright purple flowers. Mention has already been made of the variation in position of the root-crown. An exposed caudex, anomalous in sect. *Lonchocarpi*, is correlated with talus habitat and is believed to be the result of physical accident rather than an inherent character. The var. *aphyllus* represents an extreme stage in leaf-reduction.

Jones has recorded (1923, p. 71) the Colton milk-vetch from Tintic Valley in eastern Juab County, Utah, but there is no corresponding specimen at POM, and the record may have been based on an old misidentification of *A. pinonis*. A more recent range-extension to the Uinta Basin (Graham, 1937, p. 246) is based on collections of *A. (Pectinati) saurinus*, a species similar in its junceous growth-habit and purple flowers, but very different in its truly connate stipules and sessile pod. The var. *Coltoni* was apparently first collected somewhere in Utah by Capt. Bishop in 1872, but the specimens were fragmentary and mixed with the typus of *A. Episcopus* (NY).

63. ASTRAGALUS RIPLEYI

Tall and robust, strigulose nearly throughout with fine, straight, appressed hairs up to 0.35–0.5 mm. long, the herbage greenish-cinereous, the leaflets glabrous above; *stems* few, 1–6 from the subterranean root-crown, stout, erect and stiffly ascending, 4–7 dm. long, together forming graceful, broad-topped or inversely pyramidal clumps, buried at base for a space of 2–10 cm., simple, leafless and purplish below, branching upward from the first leafy node, the branches divaricate and incurved, the more vigorous ones producing spurs in most axils, often inserted between a peduncle and its subtending leaf; *stipules* 1–5 mm. long, the lowest papery-scarious, mostly broader than long, adnate to the vestigial petiole to form a bidentate sheath, decurrent around half to nearly the whole stem's circumference, becoming fragile and irregularly ruptured, the upper ones herbaceous, very shortly adnate, with deltoid or triangular-acuminate, mostly deflexed blades; *leaves* 4–9 (11) cm. long, commonly divaricate and incurved, shortly petioled or the uppermost subsessile, with 13–17 (19) rather distant, opposite or scattered, linear or linear-elliptic, or (in some upper leaves) subfiliform, obtuse, rarely subacute or truncate, loosely involute leaflets (3) 9–25 (35) mm. long, the terminal one nearly always decurrent; *peduncles* arcuate-erect, (3.5) 6–12 (15) cm. long, mostly much longer than the leaf; *racemes* loosely (5) 15–45-flowered, the flowers early declined and secund, the axis (2) 4–16 cm. long in fruit; *bracts* scarious, ovate-acuminate or lanceolate, 1–2 mm. long; *pedicels* very slender, at first straight, widely ascending, 2.3–3.5 mm. long, in fruit arched downward or twisted at base around the raceme-axis and abruptly refracted, 3–7 mm. long; *bracteoles* 0; *calyx* 5.5–7.7 mm. long, thinly strigulose with black or sometimes a few white hairs, the oblique disc 1–1.4 mm. deep, the membranous, pallid, deeply campanulate or subcylindric tube 5–6.6 mm. long, 2.9–3.3 mm. in diameter, the deltoid or triangular-subulate teeth 0.5–1.1 mm. long; *petals* pale lemon-yellow, concolorous; *banner* recurved through ± 35°, oblanceolate or rhombic-oblanceolate, (13) 14–17 mm. long, 4.5–6.3 mm. wide; *wings* (11) 12.5–14.2 mm. long, the claws 5.9–7.1 mm., the oblong-oblanceolate, obtuse, nearly straight blades 6.5–8.2 mm. long, 2.1–2.8 mm. wide; *keel* (9.5) 10–11.3 mm. long, the claws (5.5) 6–7 mm. long, the lunately half-obovate blades 4.5–5.5 mm. long, 2.2–2.6 mm.

wide, incurved through 85–95° to the bluntly deltoid apex; *anthers* 0.6–0.8 mm. long; *pod* pendulous, stipitate, the slender, straight stipe 8–15 mm. long, the body linear-oblong, lanceolate, or narrowly elliptic in profile, straight or a trifle arched downward, (1.4) 2–3.3 cm. long, (3.5) 4–6 mm. in diameter, mostly cuneate at base and tapering from above the middle into a very acute, cuspidate apex, strongly compressed laterally and 2-sided, bicarinate by the salient, subfiliform sutures, the faces at first nearly flat becoming low-convex at maturity, the thinly fleshy, green or reddish, finely strigulose valves becoming papery, stramineous, reticulate; *ovules* 11–17; *seeds* yellowish-brown, rugulose-punctate, dull, 2.8–3.4 mm. long.—Collections: 5 (ii); representative: *W. A. Weber 7788* (ARIZ, G, NY, RSA); *Ramaley & Johnson 14,747* (COLO); *G. Nisbet 10,587* (NMEX).

Dry plains and stony meadows, among sagebrush, with *Chrysothamnus* spp., or on sandy banks in juniper-piñon woodland, commonly in loamy clays overlying granitic bedrock, 7000–8250 feet, local but forming colonies, known only from the upper Rio Grande Valley in Taos County, New Mexico, and along the Conejos River in adjoining Conejos County, Colorado.—Map No. 23.—June and July.

ASTRAGALUS RIPLEYI (Harry Dwight Dillon Ripley, 1908–) Barneby in Leafl. West. Bot. 6: 175. 1952.—"4 miles south of Tres Piedras, Taos County, New Mexico . . . 8 July, 1950, *Ripley & Barneby No. 10307*."—Holotypus, CAS! isotypi, COLO, GH, K, NY, POM, RM, RSA, WS, WTU!

The Ripley milk-vetch and the species following, *A. Schmollae,* are both local, strongly marked astragali, somewhat isolated taxonomically but closely related to one another. The obcompressed pod of *A. Schmollae* is very similar to that of *A. lonchocarpus,* and it is through the Schmoll milk-vetch that the relationship of *A. Ripleyi* to the genuine *Lonchocarpi* is most readily perceived. On purely technical grounds, and especially if the lateral compression of the pod were emphasized at the expense of other characters, it would be possible to refer *A. Ripleyi* to sect. *Collini,* even though the calyx lacks the basal pouch characteristic of that section. The pod alone, in form, texture, and compression, is quite like that of *A. (Cusickiani) filipes,* but this differs much in habit of growth and in the connate lower stipules.

A handsome, tall astragalus, *A. Ripleyi* is like no other species of its region and will be recognized without difficulty by the effuse branching of the stems above their simple fistular base, by the narrow leaflets, nodding, lemon-yellow flowers, and finally by the large, pendulous, long-stipitate, bladelike pods which are commonly tinged with red in the fresh state.

64. ASTRAGALUS SCHMOLLAE

Tall and robust, strigulose throughout with fine, appressed hairs up to 0.4–0.55 mm. long, the stems green or purplish at base, the herbage cinereous, the leaflets pubescent on both sides, the inflorescence± black-hairy; *stems* few, erect and ascending from the shallowly buried root-crown, 3–6 dm. long, ribbed and fistular below, shortly branched at 1–4 nodes preceding the first peduncle, the internodes below the first branch mostly short and lacking developed leaves, the upper ones much longer, flexuous; *stipules* 2–7 mm. long, dimorphic, the lowest papery, castaneous or purplish-brown, adnate to the vestigial petiole to form an obtuse or bidentate sheath, decurrent around ½ to nearly the whole stem's circumference, the median and upper ones herbaceous, obscurely adnate, with deltoid-acuminate, triangular, or lanceolate, mostly deflexed blades; *leaves* 4–10 cm. long, shortly petioled or the uppermost subsessile, with (7) 11–21 opposite or scattered, linear, linear-oblong, or -elliptic, obtuse or retuse, flat leaflets 6–25 (30) mm. long, all articulate; *peduncles* erect, 9–21 cm. long, the first 1 or 2 usually very stout and long, the inflorescence mostly projected well beyond the main stem-axis; *racemes* loosely (7) 10–28-flowered, ultimately secund, the axis (2.5) 4.5–20 cm. long in fruit; *bracts* membranous, lanceolate or lance-ovate, 1.5–3 mm. long; *pedicels* at anthesis 1–1.3 mm. long, in fruit widely spreading, arcuately re-

curved, or deflexed, a trifle thickened, 2–2.5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 6–7.5 mm. long, rather densely and loosely black-strigulose, the slightly oblique disc 1–1.2 mm. deep, the cylindric or cylindro-campanulate tube (5) 5.5–6 mm. long, 2.6–3.2 mm. in diameter, the triangular-subulate teeth 1–1.7 mm. long, all crowded toward the dorsal side of the calyx, the ventral sinus wide and deeply cut back; *petals* ochroleucous, concolorous; *banner* recurved through ± 45°, rhombic-elliptic, deeply notched, 14.5–18 mm. long, ± 7–8 mm. wide; *wings* 13.5–17 mm. long, the claws 6–6.7 mm., the oblong-oblanceolate, obtuse, sometimes very obliquely truncate, or shallowly emarginate, nearly straight blades 8–11.8 mm. long, (1.5) 2.3–2.5 mm. wide; *keel* 9.5–11.5 mm. long, the claws 5.7–6.5 mm., the lunate blades 4.6–5.8 mm. long, 2.4–2.9 mm. wide, incurved through 95° to the broadly triangular, obtuse, obscurely porrect apex; *anthers* 0.6–0.65 mm. long; *pod* pendulous, stipitate, the straight, slender stipe 5–10 (12) mm. long, the body linear-oblanceolate in profile, (2.5) 3–4 cm. long, 3.5–5 mm. in diameter, nearly straight to gently decurved, tapering gradually downward into the stipe, shortly acuminate or cuneately acute and cuspidate at apex, obcompressed-triquetrous, with low-convex lateral and shallowly but narrowly grooved dorsal faces, carinate ventrally by the prominent, thick suture, the thinly fleshy, green, strigulose valves becoming stiffly papery, stramineous, cross-reticulate; *ovules* 18–20; *seeds* (not seen quite ripe) ± 3 mm. long.—Collections: 6 (ii); representative: *W. A. Weber 4832* (CAS, SMU, TEX, WS); *A. Nelson 10,420* (RM).

Sandy and gravelly flats and terraces, among junipers and piñons, on sandstone, 6800–7000 feet, locally abundant but known only from the plateau at the south end of Mesa Verde, Montezuma County, Colorado.—Map No. 23.—May and June.

ASTRAGALUS SCHMOLLAE (Hazel Marguerite Schmoll, 1891– , formerly curator of botany at Colorado State Museum) C. L. Porter in Madroño 8: 100, Pl. 9, figs. 4–7. 1945. —"Northwest of Spruce Tree House, Mesa Verde National Park, 6800 feet, May 26, 1925, *Hazel M. Schmoll & Deric Nusbaum 1555* (Rocky Mountain Herbarium no. 105889, flowers, no. 105888, fruit)."—Cotypi, RM!

Astragalus platycarpus var. *montezumae* (of Montezuma County) Barneby in Leafl. West. Bot. 4: 59, Pl. opp. p. 56, figs. 1–5. 1944.—"... plateau at the south end of the Mesa Verde, Montezuma County, alt. 6900 ft., *Ripley & Barneby No. 5357*."—Holotypus, CAS! isotypus, RSA!

The Schmoll milk-vetch might be described as a foliose version of *A. lonchocarpus*, having quite similar flowers and fruits but all the leaves regularly odd-pinnate and all leaflets petiolulate. The calyx of *A. Schmollae* tends to be shorter in relation to the petals, and the pod is uniformly pubescent and more narrowly grooved along the back. The known range of the species extends little over a mile or possibly two in diameter, but the plants are abundant locally in gravelly openings among the nut pines and junipers about the aboriginal dwellings. Northward on the Mesa, in oak brush at slightly greater elevations, *A. Schmollae* is abruptly replaced by the superficially similar *A. scopulorum*, which may be recognized by its truly connate stipules and sharply trigonous, laterally compressed pod.

Although only described in recent years, *A. Schmollae* was first collected in 1890 by Alice Eastwood. Her specimen (US), taken in July, was too far advanced to show the full characters of the species, but Jones recognized it as a relative of *A. Coltoni* and Rydberg identified the detached fruit as that of *A. lonchocarpus*.

65. ASTRAGALUS LONCHOCARPUS

Commonly coarse and robust, sometimes quite slender, strigulose throughout or nearly so with fine, filiform or somewhat flattened hairs up to 0.4–0.75 mm. long, the vesture variable in density, the whole plant, or the herbage, or only the growing tips cinereous or gray-silky, or more rarely greenish in part or throughout, the leaflets (when present) either equally pubescent on both sides, or more densely

pubescent above than beneath, or sometimes glabrous and minutely red-dotted above; *stems* several or numerous, erect or diffusely ascending, (2) 3–6 dm. long, together forming low, bushy, or taller, broomlike tufts, subterranean for a space of 1–8 cm., commonly stout and hollow toward the base but sometimes slender and solid or almost so, strictly and repeatedly branched upward from the first emersed node, the primary branches commonly fertile, the secondary and succeeding ones reduced to slender or filiform spurs, these sometimes inserted between a peduncle and its subtending leaf; *stipules* 1.5–9 mm. long, those at the subterranean, often approximate nodes mostly ovate and comparatively large, stiffly papery, castaneous or purplish, adnate to the suppressed petiole into a subtruncate or bidentate sheath and decurrent around ½ or more of the stem's circumference, the median and upper ones herbaceous but early turning papery and brownish, with lanceolate or triangular-acuminate, often recurving blades; *leaves* (2) 4–10 (13) cm. long, with slender, flaccid rachis, some of the lowest (usually) with 3–9 (11) distant, commonly scattered, linear or linear-oblanceolate, obtuse or subacute, involute or almost flat leaflets 2–25 (36) mm. long, the terminal one confluent with the rachis and commonly distant from and longer than the last pair, but the lateral leaflets of most upper (sometimes all) leaves reduced in number, length, or both, or wanting, the leaf then consisting of a naked rachis terminating in an obscurely expanded phyllode; *peduncles* stiffly erect or incurved-ascending, (6) 9–22 cm. long, the first 1 or 2 usually long and stout, the racemes (or most of them) projected well beyond the main stem-axis; *racemes* loosely, often interruptedly (7) 15–35 (55)-flowered, the flowers ± secundly nodding, the axis (3.5) 5–20 cm. long in fruit; *bracts* papery-membranous, ovate-acuminate or lanceolate, 0.8–2.5 mm. long; *pedicels* at earliest anthesis ascending, (1.3) 1.8–3 mm. long, early arched outward, horizontal, decurved, or abruptly deflexed, in fruit (2) 3–4 (4.5) mm. long; *bracteoles* 0; *calyx* (5.8) 6.5–10 mm. long, strigulose with white, rarely mixed with a few black hairs, the oblique disc (0.7) 1–1.7 mm. deep, the cylindric, cylindro-campanulate, rarely campanulate, reddish or pallid tube (5) 6–8 mm. long, 2.7–4 mm. in diameter, oblique at base or sometimes a trifle turgid or even gibbous dorsally, the subulate or triangular-subulate teeth (0.6) 1–2 mm. long, all crowded toward the dorsal side, the ventral pair broadest, separated by a wide, often deeply cut-back sinus; *petals* cream-colored or almost white (reportedly sometimes purplish, *Jones*); *banner* recurved through ± 50°, 13.5–19.5 mm. long, variable in outline, the long-tapering claw gradually or abruptly expanded into a broadly to narrowly rhombic-ovate, shallowly notched or scarcely emarginate blade 6–10 mm. wide; *wings* as long or slightly shorter, the claws (6.3) 7–9.5 mm., the oblong, lance-oblong, or linear, obtuse or subemarginate blades 7.5–10 (12.5) mm. long; *keel* 10.5–14 mm. long, the claws (6.2) 7–9.4 mm., the lunate blades 4.2–6.5 mm. long, 2.3–2.8 mm. wide, incurved through 90–95° to the deltoid or triangular, obtuse, sometimes slightly porrect apex; *anthers* 0.5–0.75 mm. long; *pod* pendulous, stipitate, the slender, straight stipe (3) 5–12 (15) mm. long, the body linear-oblanceolate, -elliptic, or -oblong in profile, 2.2–4.7 cm. long, 3.3–6 mm. in diameter, straight or more often gently decurved, long-acuminate downward into the stipe, sometimes equally long-acuminate upward but usually narrowly cuneate distally and cuspidate at apex, strongly obcompressed, the low-convex ventral face, or both faces, carinate by the sutures, the dorsal face sometimes flat or shallowly excavated, the lateral angles narrow but obtuse, the thinly fleshy, green or red-dotted, glabrous or rarely puberulent valves becoming stiffly papery, brown, smooth or faintly cross-reticulate and rarely striate lengthwise; *ovules* (12) 16–26; *seeds* brown, smooth, 3.5–4 long.—Collections: 60 (xv); representative: *Train 3757* (NA, NY); *Eastwood & Howell 9294* (CAS, RSA,

WS); *W. A. Weber 4717* (CAS, SMU, TEX, WS); *Barneby 12,727* (CAS, COLO, NY, RSA, UTC); *Ripley & Barneby 5270* (CAS, RSA); *Goodman & Payson 2815* (CAS).

Gullied bluffs and badlands, open gravelly or sandy hillsides in juniper-piñon woodland, most commonly in alkaline soils derived from sandstone, but occasionally on limestone, rarely on granitic bedrock, 4900-7800 feet, widespread and locally abundant over the Colorado Basin southward from Tavaputs Escarpment in Utah and western Colorado, extending less frequently west across Utah into northeastern and eastcentral Nevada, and, still fairly common, southeast, barely entering extreme northeastern Arizona, over the Continental Divide into the Rio Grande and Pecos Valleys in northwestern and central New Mexico, thence north, around the south flanks of the Rocky Mountains, to the upper Canadian, and to the Arkansas on the east slope in Colorado; in western Colorado extending rarely north to the eastern edge of the Uintah Basin in Rio Blanco County.—Map No. 23.—May to July.

ASTRAGALUS LONCHOCARPUS (with long pod) Torr. in Pac. R. R. Rep. 4[1]: 80. 1857, based on *Phaca macrocarpa* (with large pod) Gray in Mem. Amer. Acad. II, 4 (Pl. Fendl.): 36. 1849 (non *A. macrocarpus* Pall., "1776").—"Rocky declivities, near Santa Fe. No. 160."—Holotypus, collected by August Fendler in 1847, GH! isotypi, BM, K, MO, NY, PH!—*Tragacantha lonchocarpa* (Torr.) O. Kze., Rev. Gen. 946. 1891. *Homalobus macrocarpus* (Gray) Rydb. in Bull. Torr. Club 32: 667. 1891. *Lonchophaca macrocarpa* (Gray) Rydb. in N. Amer. Fl. 24: 312. 1929.

Astragalus macer (lean or thin) A. Nels. in Bot. Gaz. 56: 65. 1913.—"Secured by E. P. Walker on dry foothills, Paradox Valley, Colorado, June 24, 1912."—Holotypus, *Walker 179*, RM! isotypi, GH, NY, US, WS!—*Lonchophaca macra* (A. Nels.) Rydb. in N. Amer. Fl. 24: 313. 1929.

The great rushy milk-vetch, *A. lonchocarpus,* has so strong an individual character that once seen it is never forgotten. The sparse herbage, appearing wiry but actually soft and flaccid to the touch, the nodding, pearly-white or cream-colored flowers, and the long, narrow, pendulous pods are distinctive features. Both calyx and pod are often tinged with a bright reddish color which turns brown on drying. The pod dehisces downward through the length of the ventral suture and the valves fold outward like the covers of a book, forming an oddly leaflike structure after the seeds are shed.

A certain degree of variation, implicit in the foregoing description, must be expected in a species as widely dispersed as *A. lonchocarpus,* and only a few points require comment. The plants found at low elevations in the intermountain deserts tend to be robust, with stout hollow stems and a markedly ephedroid aspect, due to great reduction of the leaflets. A slender form, with narrow pod and narrow solid stems, has been described as *A. macer;* it is found here and there throughout the range of the species and is interpreted as a minor variant. The actual typus of *A. lonchocarpus* is closer to *Lonchophaca macra,* as defined by Rydberg, than to the coarse Basin variants with which he and A. Nelson associated the earlier name. A thinly pubescent form with glabrous or glabrescent upper leaf-surface occurs in a small area in northwestern New Mexico and adjoining Colorado, but even in its compact range does not replace (and passes into) the common cinereous state. A puberulent pod is found rarely in southwestern Colorado but is sympatric with the common glabrous form. It is interesting to find that *A. lonchocarpus* is most abundant and also most variable on the southwest flank of the Rocky Mountains, the region that has yielded its two rare relatives *A. Schmollae* and *A. Ripleyi,* and lies close to the center of its own far-flung range. The peripheral populations of *A. lonchocarpus* in Nevada and east of the Divide in Colorado are closely similar in detail. It seems a natural inference that the genuine *Lonchocarpi* had their point of origin in the upper San Juan Valley or thereabouts and that *A. lonchocarpus* has spread radially thence along available paths of migration, carrying with it a decreasing potential for mutation.

66. ASTRAGALUS HAMILTONI

Closely resembling robust states of *A. lonchocarpus,* densely strigulose with filiform or somewhat flattened, appressed hairs up to 0.4–0.6 mm. long, the herbage ± silvery-canescent, the leaflets more densely pubescent above than beneath; *stems* several, erect and ascending in clumps, 2.5–4 dm. long, leafless and fistular

toward the base, branched or spurred at 1–4 nodes preceding the first peduncle, sometimes bearing a short spur inserted between the first peduncle and its subtending leaf; *stipules* firm, early becoming papery and brownish, 1.5–9.5 mm. long, the large lower ones ovate, strongly adnate to (or united behind) the vestigial petiole, decurrent around ½ to the whole stem's circumference (exceptionally very shortly connate), the median and upper ones progressively smaller, triangular to deltoid-acuminate, the spreading blades either glabrous or pubescent dorsally; *leaves* 3–7 cm. long, at least some of the lower ones pinnate, with 1–2 (3) pairs of often irregularly inserted, oblong-oblanceolate, obtuse lateral leaflets 1–2.5 cm. long, the terminal one longer and often a trifle broader than the last pair and 1–3.8 cm. long, either obtuse or retuse, tapering into and continuous with the rachis, the upper leaves mostly reduced to a simple, shortly petiolate blade of similar outline; *peduncles* erect and incurved-ascending, 2.5–15.5 cm. long, the vigorous lower ones far surpassing the leaf; *racemes* loosely (6) 10–30 (35)-flowered, the axis (1) 2.5–11 cm. long in fruit; *bracts* firmly papery, triangular-acuminate, 1–2.5 mm. long; *pedicels* densely and rather loosely strigulose, at anthesis 1.2–2.5 mm., in fruit arched out- and downward, thickened, 1.2–3 mm. long; *bracteoles* 0–2, commonly present; *calyx* 8.2–11.5 mm. long, strigulose with white and rarely a few black hairs, the strongly oblique disc 0.9–1.7 mm. deep, the reddish or pallid, deeply campanulate tube gibbous dorsally behind the pedicel, 6.5–9.2 mm. long, 4–5.5 mm. in diameter, the ventral pair of teeth triangular-subulate, 1.7–2.6 mm. long, the rest shorter, closely approximate, the orifice oblique; *petals* ochroleucous, concolorous; *banner* recurved through 45° (further in withering), broadly rhombic-oblanceolate, notched, 20–24 mm. long, 7.4–12 mm. wide; *wings* 17.7–22.5 mm. long, the claws 8.5–10.8 mm., the linear, lanceolate, or narrowly elliptic, obtuse, nearly straight blades 10–12.7 mm. long, 2–3.8 mm. wide; *keel* 13.7–16.6 mm. long, the claws 8.1–10.5 mm., the half-obovate blades 6.2–7.7 mm. long, 3–3.7 mm. wide, abruptly incurved through 90° to the bluntly deltoid apex; *anthers* (0.65) 0.75–1.1 mm. long; *pod* pendulous, stipitate, the slender, strigulose stipe 9.5–12 mm. long, the body narrowly ellipsoid, 2.5–3.5 cm. long, 5.5–7.5 mm. in diameter, cuneately tapering at both ends, cuspidate at apex, straight or nearly so, obcompressed, low-convex ventrally and carinate by the prominent, thick suture, flattened dorsally, the green, thinly fleshy valves becoming papery and brownish, finely cross-reticulate and wrinkled lengthwise, sparsely strigulose in the lower half but glabrescent or glabrous distally; *ovules* 16–22; *seeds* unknown.—Collections: 5 (i); representative: *Barneby 12,711* (CAS, K, NY, POM, RSA, UTC); *B. Untermann 15a* (BRY).

Gullied banks and ridges, in soft sandy clay soil overlying sandstone, with Utah juniper, ± 5200–5400 feet, locally plentiful but known only from Asphalt Ridge at points ± 5 miles southwest and due west of Vernal, Uintah County, Utah. —Map No. 23.——May and June.

ASTRAGALUS HAMILTONI (the discoverer) C. L. Porter in Rhodora 54: 159. 1952.—"TYPE: *J. W. Hamilton & O. A. Beath*, s. n., on the Wahsatch formation, 5 miles south of Vernal, Uintah County, Utah, May 24, 1950 . . . PARATYPE: *C. L. Porter 5313*, from the same locality, June 3, 1950."—Holotypus, RM! isotypus, GH! paratypi, GH, MO, NY, RM, SMU, TEX!

The Hamilton milk-vetch is poorly distinguished from *A. lonchocarpus*. Stipules, flowers, except for small differences in size, and pods are almost identical in the two species. The few broad leaflets, reduced in number but scarcely in size upward along the stems, create a strong and lasting impression of distinctness, but the modification in the foliage is hardly enough to counterbalance similarities in other organs. The species is known at present from a very small area, possibly from only two populations, so that a verdict on its taxonomic status is probably premature. The main range of *A. lonchocarpus* lies south of Tavaputs Escarpment, but it is known to occur in one place on the White River within the Uintah Basin about 60

miles east of Vernal. Forms intermediate in leaf characters are to be sought in the intervening territory.

The Torrey and Kew herbaria have possessed specimens of *A. Hamiltoni* for well over a century, collected on the Uintah River by Fremont on June 5, 1844. It must have formed part of the "rich addition to our botanical collection," mentioned in Fremont's Report (1854, p. 279) as having been obtained in transit between the old Fort Uintah and Ashley's Fork, that is, in the badlands lying between Vernal and Fort Duchesne.

XIII. Sectio DRABELLAE

Low and tufted, or diminutive and matted or pulvinate perennials, with taproot and superficial root-crown or caudex; *vesture* dolabriform, the herbage commonly silvery; *stipules* membranous becoming scarious, imbricated, connate; *leaves* dimorphic, the lowest of the year's growth-cycle reduced to short, spatulate or oblanceolate pyllodes, the later ones either similar but longer and narrower or 3–7-foliolate, the lateral leaflets narrow, sessile but articulate; *flowers* subumbellate or racemose, ascending, of small or moderate size, the banner 6–20 mm. long; *calyx-tube* campanulate or turbinate-campanulate; *petals* pink-purple, exceptionally lurid or white, the banner recurved through 45–90°, the keel-tip obtuse; *pod* erect, or humistrate and ascending, sessile, subpersistent or tardily disjointing, oblong-elliptic or linear in profile, usually laterally compressed and bicarinate by the sutures, the valves sometimes laterally distended, more rarely bluntly trigonous and sulcate dorsally, the papery valves not inflexed; *ovules* 4–24.—Spp. 5, xerophytes, 1 widely dispersed from northeastern Utah and southwestern Idaho to Montana, southern Saskatchewan, and central Colorado, 2 endemic to the Uinta Basin in Utah and northwestern Colorado, 2 local in Wyoming.

ASTRAGALUS sect. DRABELLAE (T. & G.) Barneby in Leafl. West. Bot. 5: 3. 1947, based on *Homalobus* sect. *Drabellae* T. & G., Fl. N. Amer. 1: 352. 1838.—Sp. typica: *H. caespitosus* Nutt. = *A. spatulatus* Sheld.

Astragalus sect. *Homalobi* subsect. (or ser.) *Condensati* Gray in Proc. Amer. Acad. 6: 231. 1864.—Sp. unica: *A. simplicifolius* (Nutt.) Gray.

Homalobus sect. *Caespitosi* Rydb. in Bull. Torr. Club 50: 178. 1923.—Sp. typica: *H. caespitosus* Nutt. = *A. spatulatus* Sheld.

Homalobus sect. *Simplicifolii* Rydb. in N. Amer. Fl. 24: 259. 1929.—Sp. typica: *H. simplicifolius* (Nutt.) Rydb. = *A. simplicifolius* (Nutt.) Gray.

The section *Drabellae* is one of the most compact and easily defined groups of North American *Astragali*, differing from all others by the acaulescent life-form, dolabriform hair-attachment, and leaves partly or wholly transformed into spatulate or oblanceolate phyllodes. The pod is unilocular, but varies considerably in length and in mode of compression. The fruit of the one common species, *A. spatulatus*, is small and typically homaloboid in design, being laterally flattened and carinate by both sutures. That of *A. detritalis* is technically similar, but greatly elongated, whereas in *A. simplicifolius* the valves are laterally distended. The pod of *A. drabelliformis* is superficially quite unlike that of the others in being trigonously compressed and grooved dorsally. In spite of its many specialized features the section is evidently akin to the *Genistoidei*, from among which the more condensed states of *A. miser* var. *decumbens* might be picked out as especially suggestive of *A. spatulatus;* from this it differs in the development of at least one visible internode, in the pinnate lower leaves, and in the declined persistent fruits. It seems reasonable to consider *A. spatulatus*, the most widely dispersed of the five *Drabellae*, as relatively primitive, possibly representing the archetype of the section or at least a close lineal descendent. The remaining species, all rare and local, exhibit further specializations involving the pod, the foliage, or both.

The following account follows, except where noted, a recent revision of sect. *Drabellae* (Barneby, 1947), in which some historical aspects of the species are treated at greater length.

Key to the Species of Sect. Drabellae

1. Plants low, tufted, matted, or pulvinate, the longest leaves not over 8 cm. long; *racemes* 1–9 (11)-flowered, the axis not over 3.5 cm. long in fruit; *calyx-teeth* erect (2)
2. Flowers small, the banner 5–9.5 mm. long, the keel 3.7–6.2 mm. long; *pod* not

over 15 mm. long; *calyx* not prominently 5-nerved in fruit; widespread over the range of the section (3)

3. Pod laterally compressed, bicarinate by the sutures, 2-sided; widespread over the range of the section ..... 67. *A. spatulatus*

3. Pod trigonously compressed, carinate by the ventral suture but openly grooved dorsally; local in the upper Green River Valley, Sublette County, Wyoming ..... 69. *A. drabelliformis*

2. Flowers larger, the banner 10.5–20 mm. long, the keel 7–13.4 mm. long; either the *pod* longer, or the fruiting *calyx* prominently 5-nerved; rare and local species (4)

4. Pod ovoid or lance-ellipsoid, 6–15 mm. long, 2–5 mm. in diameter; *leaves* all reduced to phyllodia; *ovules* 11–14; Wyoming ..... 70. *A. simplicifolius*

4. Pod linear-oblong or linear in profile, 15–35 mm. long, 2–3.5 mm. in diameter; *leaves* dimorphic, the upper ones imparipinnate; *ovules* (15) 16–24; Uinta Basin, n.-e. Utah and n.-w. Colorado ..... 71. *A. detritalis*

1. Plants taller, the longest leaves at least (7) 10 cm. long; *racemes* very loosely 7–23-flowered, the fruiting axis (4.5) 6–18 cm. long; *calyx-teeth* stellately spreading; Uinta Basin (near Dinosaur National Monument) ..... 68. *A. chloödes*

67. Astragalus spatulatus

Low, dwarf, or diminutive, tufted, matted, or pulvinate, the repeatedly forking caudex beset with a thatch of persistent stipules and leaf-bases, the herbage densely strigulose with fine, straight, appressed, or some looser and sinuous, but commonly parallel and contiguous hairs up to 0.5–0.9 (1) mm. long, silvery or cinereous; *stems* mostly reduced to crowns, the year's growth not exceeding 1.5 cm. in length, the internodes all concealed by imbricated stipules, together forming small tufts, prostrate mats, or domed cushions up to 3 dm. in diameter, mostly smaller; *stipules* papery-scarious, 2–7 mm. long, those of the short outer phyllodia the smallest, all amplexicaul and connate through at least half their length into a bidentate or subentire sheath, either all glabrous dorsally, all strigulose, or the outer ones only pubescent, the margins bristly-ciliate, at least distally; *leaves* all or mostly reduced to phyllodia, ± dimorphic, the lower ones spreading or decurved, 0.3–1.5 cm. long, oblanceolate or narrowly spatulate, nearly always expanded upward into a definite blade as long or longer than the petiole-like base, the later ones similar but more erect, always longer and commonly narrower, (1) 1.5–6 cm. long, oblanceolate or linear-oblanceolate, acute, mucronulate, or subacute, mostly simple, but a few sometimes bearing 1 (2) pairs of lateral leaflets similar in shape, the blades either flat, or with elevated or involute margins; *peduncles* erect or ascending at anthesis, the outer ones of a plant often prostrate in fruit, 0.4–7 cm. long, in the most condensed states barely surpassing the stipules, but in the looser ones sometimes surpassing the longest leaf; *racemes* shortly but loosely, more rarely subcapitately (1) 2–9 (11)-flowered, the axis 1–35 mm. long in fruit; *bracts* scarious, ovate, lanceolate, or lance-attenuate, somewhat involute, 0.5–4 (6) mm. long; *pedicels* ascending, straight or nearly so, at anthesis 0.3–1.7 mm., in fruit 0.7–3 mm. long, persistent until or after the fruit is ripe; *bracteoles* 0, rarely present and up to 3 mm. long; *calyx* (2.6) 3.5–5 mm. long, densely strigulose with white, partly black, or wholly black hairs, the symmetric disc (0.3) 0.4–0.6 mm. deep, the campanulate or obconic-campanulate tube 1.9–3 (3.4) mm. long, 1.5–2.1 mm. in diameter, the erect, subulate, sometimes incurved teeth 0.5–2.3 (2.5) mm. long; *petals* bright pink-purple with white wing-tips, rarely cream-colored, veined and suffused with dull lilac, exceptionally white; *banner* recurved through ± 45°, sometimes further, (5.7) 6.5–9.5 mm. long, variable in outline, the cuneate claw expanded into an ovate, obovate, or less often rhombic-elliptic or suborbicular, notched blade (4.1) 4.5–6.7 mm. wide; *wings* (5.1) 6–8.3 mm. long, the claws (1.7) 2–3.2 mm., the lunately oblong-elliptic or -oblanceolate, obtuse

blades (3.6) 4–5.8 mm. long, (1.3) 1.6–2.3 mm. wide, both incurved but the left one more strongly so and its inner margin infolded; *keel* (4) 4.5–6.2 mm. long, the claws (1.5) 1.9–3.2 mm., the obliquely obovate or half-circular blades 2.2–3.3 mm. long, 1.5–2.1 mm. wide, abruptly incurved through 100–135° to the rounded, rarely subporrect apex; *anthers* (0.25) 0.3–0.5 mm. long; *pod* erect or ascending at a narow angle, sessile, commonly disjointing before dehiscence but sometimes subpersistent, narrowly lanceolate, lance-oblong, or ovate in profile, (4) 5–13 mm. long, 1.5–3 (3.3) mm. in diameter, straight or a trifle incurved, rounded at base, abruptly acute or shortly acuminate at apex, cuspidate, laterally compressed and 2–sided, bicarinate by the salient sutures but more sharply so ventrally, the faces low-convex (more turgid toward the dorsal suture), the pale green, purple-tinged, or finely red-mottled valves becoming papery, brown or stramineous, smooth or reticulate toward the angles, nearly always strigulose, occasionally glabrous; *dehiscence* at first apical, ultimately through the base and the ventral suture; *ovules* (4) 6–10 (12); *seeds* pale ocher, olivaceous, or purplish-brown, ± rugulose, (1.4) 1.7–2.6 mm. long.—Collections: 107 (xxvi); representative: *J. Macoun* (from Cypress Hills) *in 1894* (NY); *Hitchcock & Muhlick 11,888* (NY, RSA, WS); *Christ 14,481* (NY); *A. Nelson 1301* (NY, OB, RM, WIS), *4319, 7289* (NY, RM); *C. L. Porter 4161* (NY, RM, SMU, TEX), *5402* (CAS, NY, RM, TEX); *Ripley & Barneby 7916, 8715, 8770, 10,523* (CAS, RSA).

Hilltops, bluffs, knolls, weathered outcrops, and bare places on open hillsides or prairies, in light gravelly or sandy soils nearly always of sedimentary origin, preferring shales and sandstones, 2300–8600 feet, widespread and locally common over the northern Great Plains, from southwestern Saskatchewan, adjoining Alberta, and eastcentral Montana south through Wyoming, extreme western North and South Dakota and western Nebraska to the upper North Platte and Cache-la Poudre Rivers in northern Colorado, extending west of the Continental Divide to the Green River and Uinta Basins in northwestern Colorado, northeastern Utah, and southwestern Wyoming, and thence feebly into the Snake River drainage as far as Cassia County (Mt. Harrison), Idaho; apparently isolated on the Arkansas River in Fremont County, Colorado (Cañon City).—Map No. 26.—May to July.

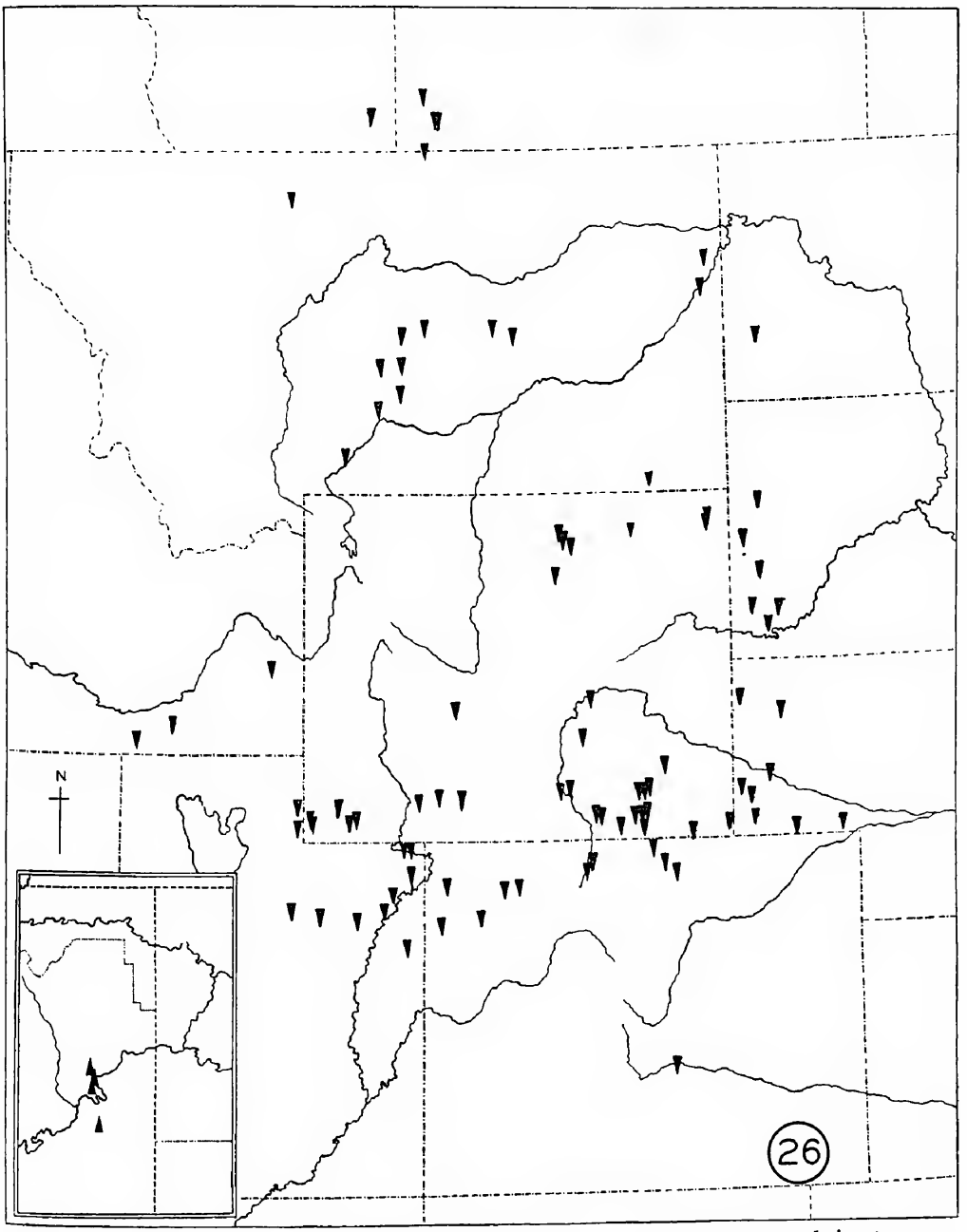
ASTRAGALUS SPATULATUS (spoon-shaped, of the phyllodia) Sheld. in Minn. Bot. Stud. 1: 22. 1894, based on *Homalobus caespitosus* (tufted) Nutt. ex T. & G., Fl. N. Amer. 1: 352. 1838.—"Dry and lofty hills of the Platte towards the Rocky Mountains . . ."—Holotypus, labeled by Nuttall "*Homalobus *caespitosus.* R. Mts. Platte," BM! isotypi, some labeled "Platte to the Mts." or "High hills of the Platte," GH, K, NY, PH!—*Astragalus caespitosus* (Nutt.) Gray in Proc. Amer. Acad. 6: 230. 1894 (non Pallas, 1800). *Tragacantha caespitosa* (Nutt.) O. Kze., Rev. Gen. 943. 1891. *Astragalus simplicifolius* var. *caespitosus* (Nutt.) Jones in Proc. Calif. Acad. Sci. II, 5: 647. 1895. *A. simplicifolius* var. *spatulatus* (Sheld.) Jones, Contrib. West. Bot. 10: 65. 1902. *A. spatulatus* var. *typicus* Barneby in Leafl. West. Bot. 5: 4. 1947.

Homalobus canescens (turning white) Nutt. ex T. & G., Fl. N. Amer. 1: 352. 1838.—"On the high chalky hills of the Platte towards the Rocky Mountains."—Holotypus, labeled by Nuttall "*Homalobus *canescens.* R. Mts.," BM! isotypi, some labeled "R. Mts./Platte," GH, K, NY, PH!

Homalobus brachycarpus (with short pod) Nutt. ex T. & G., Fl. N. Amer. 1: 352. 1838.—"With the preceding," i.e., *H. caespitosus.*—Holotypus, labeled by Nuttall "*Homalobus *brachycarpus.* High hills of the Platte." BM! isotypi, GH, K, NY, PH!—*Astragalus simplex* (simple, of the leaves) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Nev. Utah): 330. 1925, a legitimate substitute (non *A. brachycarpus* MB., 1808). *A. spatulatus* var. *simplex* (Tidest.) Tidest. in Proc. Biol. Soc. Wash. 50: 20. 1937.

Homalobus uniflorus (one-flowered) Rydb. in Bull. Torr. Club 34: 49. 1907.—"Wyoming: Evanston, 1897, *Aven Nelson 2971.*"—Holotypus, collected May 28, 1897, NY!—*Astragalus spatulatus* var. *uniflorus* (Rydb.) Barneby in Leafl. West. Bot. 5: 5. 1947.

The draba milk-vetch, *A. spatulatus,* is variable in size of all its parts and especially so in stature. The large extreme is a loosely tufted plant with strongly developed secondary leaves, some of them often 3-, rarely 5-foliolate, with scapes surpassing the leaves, racemes of up to ten comparatively large flowers, and lanceolate pods up to 13 mm. long. On the other hand, the mat or cushion form of the species has shorter and often broader phyllodia sometimes not over 15 mm. long, depauperate racemes of tiny flowers scarcely exserted or embedded in the foliage, and short pods of plumper outline. As circumscribed by growth-habit alone, these two aspects of *A. spatulatus* have somewhat different areas of dispersal; the dwarfer is characteristic of the high deserts and arid plains of southern Wyoming and the Uinta Basin; the taller is



Map No. 26. Montana, Wyoming, Colorado, and parts of contiguous states, and, inset, course of the Green River through the northeastern corner of Utah and adjoining Colorado. Range of *A. spatulatus*; and of *A. chloödes.*

chiefly a prairie plant and largely (but not exclusively) confined to lower elevations. It was this distributional factor that was decisive in favor of maintaining a var. *uniflorus* for the smaller type. The smallest flowers and fruits occur only on the matted or pulvinate form, and the largest on the more loosely tufted; but although the whole ranges of variation are fairly well correlated, there is a complete sequence of intergrades in each character when examined separately. The pulvinate plant is better interpreted as an immediate product of its environment. This argument gains force from observing that individuals in a population of a few hundred within a restricted area may vary considerably according to accident of situation on a hillside, the shelter of a boulder being enough to restore the normal stature. In spite of this, the populations of *A. spatulatus* in Utah and southern Wyoming possess individuality beyond mere nanism; and it is not difficult to imagine that they may have acquired, by accumulation of very small mutations favoring survival in a harsh climate of winds and drought, a certain genetic stability. For the present it must suffice to point out that the extreme forms of the draba milk-vetch are connected by a series of intermediates separable only by arbitrary quantitative standards of comparison, and var. *uniflorus* is accordingly treated here as a minor variant.

The number of ovules is very imperfectly correlated with size of the pod, although the small pod appears to mature fewer and smaller seeds. The fruit of the pulvinate form, seldom collected in fully ripe condition, perhaps falls more readily from the receptacle than is usual in the prairie type. These points deserve fuller enquiry.

The pod of *A. spatulatus* is almost always strigulose, but the vesture varies in density, and there are two examples of truly glabrous fruits. In one of these (Fremont County, Wyoming, *Ripley & Barneby 8930,* RSA) the pod was hairless in all plants collected; in the other (Duchesne County, Utah, *No. 8702,* RSA) it was glabrous in some plants and thinly pubescent in others.

The draba milk-vetch is always a delicately attractive little plant, but its condensed state (well illustrated, as *A. simplicifolius,* in King's Report, Pl. XII, figs. 3–9) becomes spectacular during its short season of bloom. On stony hilltops and red beds in southern Wyoming, and especially on the white and tawny shales of the Uinta Basin, the mats of silvery foliage disappear beneath a veil of pink-purple blossom, with the first warm days of spring. In some places the color of the petals varies from plant to plant through tones of rose, lilac, and magenta into a deep claret-purple. Elsewhere the anthocyanic pigment blends into an ochroleucous background, turning lurid in consequence. And occasional albino forms occur.

68. Astragalus chloödes

Low, tufted, with a multicipital caudex beset with remains of stipules and leaf-bases, silvery- or gray-strigulose nearly throughout with fine, appressed, straight and parallel hairs up to 0.55–0.75 mm. long; *stems* of the year reduced to crowns or nearly so; *stipules* scarious, pallid except for the prominent herbaceous midrib, 2–8 mm. long, those of the lowest leaves smallest, all amplexicaul and connate through over half to nearly their whole length into a loose, bidentate sheath, densely strigulose dorsally, at least when young; *leaves* all reduced to phyllodia, dimorphic, the lowest spreading, linear-oblanceolate, 1–4.5 (7) cm. long, gradually expanded upward into a ± involute blade up to 2.5 mm. wide, early withering-persistent, the later ones erect, stiff, narrowly linear, very acute and subspinulose at apex, (6) 10–17 cm. long, usually tightly inrolled, subterete but ventrally channeled, less than 1 mm. in diameter, occasionally with only the margins elevated and then up to 1.4 (2) mm. wide; *peduncles* scapose, erect, slender, wiry, (2) 4–9 cm. long, shorter than the longer leaves; *racemes* very loosely 7–23-flowered, the flowers ascending, the axis (4.5) 6–24 cm. long in fruit; *bracts* scarious, boat-shaped, ovate or lanceolate, mostly acute, 2–4.5 mm. long; *pedicels* erect or narrowly ascending, at anthesis slender, 1–2 mm., in fruit somewhat thickened, 1.5–2.5 mm. long, tardily, if at all, disjointing; *bracteoles* 0; *calyx* 4.5–6.7 mm. long, densely white-strigulose, the symmetric disc 0.4–0.8 mm. deep, the campanulate tube 2–3 mm. long, 1.8–2.3 mm. in diameter, becoming papery and strongly 5-nerved in age, the narrowly subulate-aristiform, very acute, somewhat rigid, stellately spreading teeth 2.5–4 mm. long; *petals* pink-purple, the banner striate; *banner* sharply recurved through ± 90°, suborbicular-cuneate, notched, 6.2–8.2

mm. long, 5–7.4 mm. wide; *wings* 6.3–8 mm. long, the claws 2.3–2.9 mm., the oblong-elliptic, obtuse blades 4.3–5.6 mm. long, 1.6–2 (2.5) mm. wide, both incurved but the left one more so than the right and its inner margin infolded; *keel* 6–6.6 mm. long, the claws 2.4–3.2 mm., the blades 4–4.8 mm. long, 2.1–2.6 mm. wide, incurved through ± 100° to the triangular, subacute apex; *anthers* 0.4–0.5 mm. long; *pod* erect or narrowly ascending, tardily deciduous from the receptacle, obliquely lanceolate or oblong-elliptic in profile, a trifle incurved just above the base and straight thereafter, 8–12 mm. long, 1.7–3 mm. in diameter, rounded at base, tapering distally into the cuspidate apex, laterally compressed and two-sided, bicarinate by the sutures (the ventral one the thicker and more prominent), the faces low-convex, the thinly fleshy, green but often purple-speckled or minutely red-mottled, glabrous or strigulose valves becoming stramineous, stiffly papery, reticulate near the sutures but smooth toward the middle; *ovules* 4–8, commonly 6; *seeds* not seen—Collections: 7 (iii); representative: *Graham 7718* (GH, US); *W. A. Weber 5312* (CAS, SMU); *Holmgren & Tillett 9530* (CAS, MO, NY, RSA); *Barneby 12,713* (CAS, NY).

Ledges and pockets of sandstone cliffs or outcrops, sometimes on talus slopes, 4800–5550 feet, forming colonies but very local, known only from about the mouth of the Green River gorge within and near Dinosaur National Monument, Uintah County, Utah.—Map No. 26.— May to early July.

ASTRAGALUS CHLOÖDES (grasslike, of the phyllodia) Barneby in Leafl. West. Bot. 5: 6. 1947.—"UTAH: . . . 6 miles southeast of Jensen, Uintah Co. . . . 7 June 1946 . . . *Ripley & Barneby No. 7797.*"—Holotypus, CAS! isotypi, GH, K, NY, POM, RM, RSA, UTC!

Because of the singular modification of the principal leaves into stiff and narrow, usually involute and sharp-pointed phyllodes, which resemble the blades of some xerophytic grasses, it would be difficult to recognize a member of the Bean Family in sterile plants of the grass milk-vetch. The flowers and pods, however, are quite similar to those of *A. spatulatus,* of which *A. chloödes* might be described in loose terms as a drawn-out or etiolated version. Apart from the greater length of the phyllodes and the much looser, longer, more numerously flowered racemes, the species is remarkable for its prominently 5-nerved fruiting calyx and the subulate-aristiform, stellately spreading calyx-teeth.

The grass milk-vetch is closely and obligately associated with the white sandstone of the Navajo Series which forms the portals of Split Canyon, where the Green River issues from its passage through the Uinta Mountains out onto the Basin floor. Of the seven collections examined, four are from near the headquarters of Dinosaur Monument, two from the type-station southeast of Jensen, and one from Brush Creek at a point about thirteen miles northeast of Vernal. The known range of the species is about fifteen miles in diameter. The plants occur on ledges of vertical cliffs, on talus, and along seams of domed or shelving wind-sculptured rocks, where they form large, spiky tufts anchored by a stout, woody, deeply penetrating taproot.

According to Graham (1937, p. 249, as *A. moencoppensis*), *A. chloödes* was first discovered in 1912 by O. A. Peterson, member of a Carnegie Museum paleontological field party.

69. ASTRAGALUS DRABELLIFORMIS

Dwarf or diminutive, matted or low-pulvinate, with a taproot and repeatedly forking, suffruticulose caudex beset with a thatch of marcescent leaf-bases impacted with sand or clay, densely strigose-strigulose with appressed (and sometimes a few subappressed) hairs up to (0.5) 0.6–1.5 mm. long, the herbage silvery-canescent, the phyllodia equally pubescent on both sides; *stipules* membranous, pallid, 1.5–5 mm. long, all fully amplexicaul and connate into a bidentate sheath, the shorter outer ones of the year's cycle pubescent dorsally, the inner longer ones glabrous dorsally or nearly so, ciliate distally; *leaves* dimorphic, the lower ones oblanceolate or spatulate, mostly less than 1 cm. long, the later ones linear-oblanceolate, acute or subacute, 1–2.5 cm. long; *peduncles* subfiliform, ascending at anthesis, prostrate in fruit, 1–2.5 cm. long, much shorter to a little longer than the

longest phyllodia; *racemes* loosely but very shortly 1–4-flowered, the axis in fruit 0–5 mm. long, prolonged as a filiform appendage beyond the last flower; *bracts* submembranous, subulate, 0.6–1 mm. long; *pedicels* ascending, at anthesis 0.6–1 mm., in fruit scarcely thickened, 0.6–1.2 (2) mm. long; *bracteoles* 0; *calyx* strigulose with white or mixed black and white hairs, 2.5–3.3 mm. long, the subsymmetric disc 0.4–0.6 mm. deep, the campanulate or turbinately campanulate tube 1.7–2.1 mm. long, (1.2) 1.4–1.7 mm. in diameter, the subulate teeth 0.8–1.2 mm. long, the whole becoming papery, ruptured, marcescent; *petals* pink-purple, drying bluish, the banner with a pale eye; *banner* recurved through 50–70°, ovate-cuneate to spatulate-obovate, shallowly notched, 5.2–7 mm. long, 3.6–5.8 mm. wide; *wings* 4.8–6.3 mm. long, the claws 1.8–2.1 mm., the elliptic-oblanceolate, obtuse, slightly incurved blades 3.6–4.8 mm. long, 1.2–1.8 mm. wide; *keel* 3.7–4.3 mm. long, the claws 1.7–2.2 mm., the half-obovate blades 2.1–2.7 mm. long, 1.4–1.7 mm. wide, abruptly incurved through 100–120° to the bluntly deltoid apex; *anthers* (0.25) 0.3–0.4 mm. long; *pod* ascending (commonly humistrate), sessile, tardily deciduous, narrowly and obliquely lance-ellipsoid, slightly incurved, 5.5–8.5 mm. long, 1.8–2.5 mm. in diameter, broadly cuneate or rounded at base, contracted at apex into a subulate cusp ± 0.5 mm. long, the body obcompressed-triquetrous, carinate ventrally by the salient suture, openly sulcate dorsally through the lower ⅔–¾, the lateral angles rounded, the green or sometimes red-mottled, scarcely fleshy valves becoming stramineous, papery, not inflexed, rather densely strigulose with short, straight hairs; *dehiscence* and *seeds* unknown; *ovules* 7–11.—Collections: 3 (iii); representative: *Barneby 13,206* (NY, RSA).

Summits and gullied slopes of low sandy or stony clay bluffs, 6900–7150 feet, forming colonies in open spaces among dwarf sagebrush, locally plentiful but known only from the upper Green River Valley between Big Piney and Daniel, Sublette County, Wyoming.—Map No. 27.—Late May to early July.

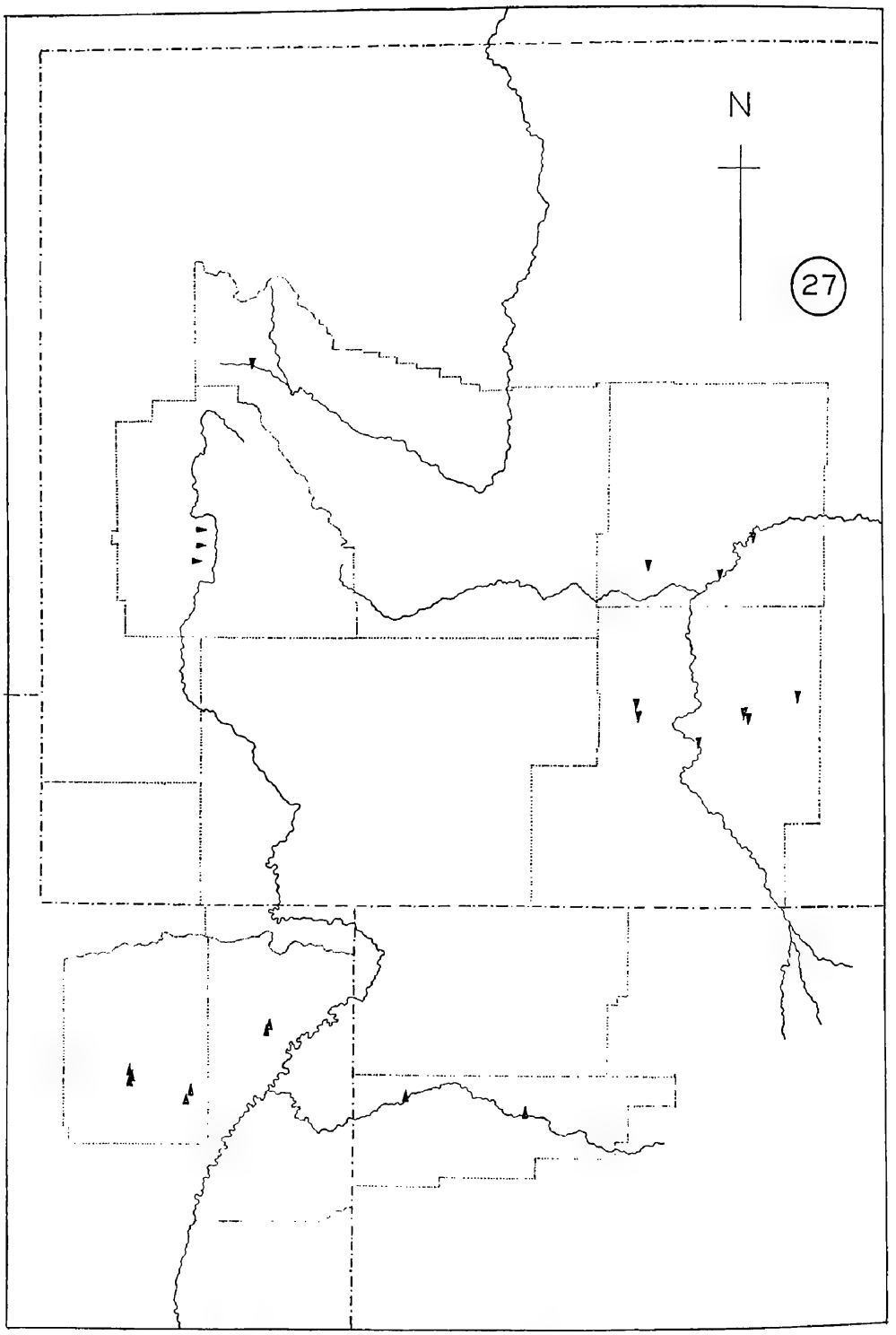
ASTRAGALUS DRABELLIFORMIS (with habit of sect. *Drabellae,* but an anomalous pod), sp. nov., cum *A. spatulati* Sheld. formis depressis vel pulvinatis habitu toto, foliorum florumque forma subexacte congruens, sed legumine obtuse trigono dorso aperte sed profunde sulcato nec (more *Homalobi*) de latere compresso suturis bicarinato valde diversa. Habitus *Homalobi* cum legumine *Batidophacae* in eadem specie genera ista arte et contra naturam circumscripta esse evincet!—Herba acaulescens densissime caespitosa vel pulvinata, pilis mediofixis appressis incana; *folia* omnia in phyllodia reducta, ima brevia spatulata, superiora lineari-oblanceolata ad 2.5 cm. usque longa, stipulis membranaceis pallidis ocreantibus suffulta; *racemi* 1–4-flori, scapo filiformi foliis multo breviori vel subaequilongo; *calycis* 2.5–3.3 mm. longi dentes subulati ± 1 mm. longi; *petala* purpurea iis *A. spatulati* Sheld. simillima, *vexillo* 5.2–7 mm., carina 3.7–4.3 mm. longa; *legumen* adscendens sessile lanceolato-ellipsoideum 5.5–8.5 mm. longum 1.8–2.5 mm. diametro, leviter incurvum, triquetrim compressum, sutura ventrali prominula carinatum, dorso aperte sed profundiuscule sulcatum, angulis lateralibus obtusis, sectione transversali obcordata, valvulis chartaceis strigulosis viridibus nunc maculatis haud inflexis.—WYOMING: 8 miles north of Big Piney, Sublette County, June 13, 1961, *Barneby 13,200.*—Holotypus, CAS! isotypi, GH, NY, RM, RSA, US!—Also 11 miles south of Daniel, Sublette County, June 13, 1961, *Barneby 13,202.*—Paratypi, BRY, CAS, NY, RM, RSA, US!

The bastard draba milk-vetch, *A. drabelliformis,* closely resembles the low tufted or mounded forms of *A. spatulatus* found in southern Wyoming and northern Utah (the so-called var. *uniflorus,* or *A. simplex*). The two species are essentially identical in habit of growth, in foliage and stipules, and in fine detail of the calyx and petals, and no means of distinguishing the two at anthesis is apparent. The pods, however, are remarkably different. The fruit of *A. spatulatus* is of the common homaloboid type, flattened laterally and keeled by both sutures, whereas that of *A. drabelliformis* is bluntly trigonous, carinate only by the ventral suture, and grooved dorsally nearly its whole length. The pod of the new species resembles that of several caulescent astragali with connate stipules and pinnate foliage referred by Rydberg to *Batidophaca,* a genus designed to accommodate species with shortly bell-shaped calyx and unilocular pods intermediate in mode of compression between *Homalobus, Phaca* (sensu Rydberg) and *Xylophacos.* The name *Batidophaca* was derived from the Greek *batis,* a skate, combined with the generic epithet *Phaca,* implying that the normally fish-shaped (laterally compressed)

fruit of *Homalobus* had become dorsiventrally flattened after the fashion of the flat fishes such as sole or flounder. This modification has doubtless occurred independently several times in *Astragalus*, and very likely has been effected in both directions. The majority of homaloboid pods in North America seem to have been derived from a primitive terete type, but here a trigonous compression has arisen from the homaloboid one. Only a deeply prejudiced observer could suggest that *A. drabelliformis*, on account of its trigonous pod alone, is more closely related to some *Batidophaca*, such as *A. humistratus*, than to the *Drabellae* of which it has all other characters intact. It should be mentioned in this connection that the pod of *A. simplicifolius*, a close relative of both *A. spatulatus* and *A. drabelliformis*, exhibits a somewhat intermediate stage of modification. Both sutures remain salient, but the middle of the valves is dilated sideways, yielding a rhombic rather than narrowly elliptic and typically homaloboid section. Since the dorsal suture in *A. drabelliformis* is recessive, the section is inversely cordate.

70. Astragalus simplicifolius

Dwarf or diminutive, densely matted or pulvinate, with a woody taproot and repeatedly forking caudex beset with a thatch of persistent stipules and leaf-bases, densely strigulose with fine, appressed, straight or nearly straight, mostly parallel and contiguous hairs up to 0.5–0.9 mm. long, the herbage silvery or rarely greenish-cinereous; *stems* very numerous, reduced to crowns, together forming flat or domed cushions up to 2 dm. in diameter, mostly less; *stipules* membranous, pallid, 3–6 mm. long, amplexicaul and connate through half or nearly their whole length into a bidentate sheath, glabrous or nearly so dorsally, bristly-ciliate; *leaves* all or nearly all reduced to phyllodia, ± dimorphic, the lower ones spreading or recurved, narrowly spatulate or oblanceolate, 4–10 mm. long, the inner ones erect or arcuate-ascending, longer and narrower, linear or linear-oblanceolate, acute or mucronulate, up to (1) 1.5–2.5 cm. long, involute, a few of them sometimes bearing a pair of obscurely jointed lateral leaflets of similar form; *peduncles* slender, erect or ascending, (0.5) 1–3 cm. long, usually shorter than the longest leaves; *racemes* loosely but very shortly 1–3 (4)-flowered, the flowers ascending, the axis not over 5 mm. long in fruit, often produced beyond the last flower; *bracts* scarious, mostly ovate, 0.4–1.8 mm. long; *pedicels* ascending, straight, at anthesis 0.5–1.8 mm., in fruit somewhat thickened, 0.8–2.4 mm. long, tardily disjointing; *calyx* 4.5–7 mm. long, rather thinly strigulose with white hairs, the subsymmetric disc ± 0.8 mm. deep, the membranous, often purplish tube 3–4.1 mm. long, 2.4–2.7 mm. in diameter, the broadly subulate teeth 1.3–3 mm. long, the tube in fruit becoming papery-membranous, somewhat distended, prominently 5-nerved, the nerves produced into the firm or rigid teeth, the whole withering-persistent about the base of the fruit; *petals* pink-purple, the banner pale-eyed; *banner* recurved through ± 45°, ovate-cuneate, shallowly notched, 10.6–12 mm. long, 6–7 mm. wide; *wings* 9.8–11.6 mm. long, the claws 4–5.2 mm., the lance-elliptic blades 6.5–7.1 mm. long, 2–2.4 mm. wide, both incurved but the left one more strongly so and its inner margin infolded; *keel* 7–9.6 mm. long, the claws 3.7–5.4 mm., the half-obovate blades 3.8–4.8 mm. long, 2.2–2.5 mm. wide, incurved through 90–100° to the rounded apex; *anthers* 0.45–0.55 mm. long; *pod* ascending (often humistrate), sessile, tardily disjointing, narrowly ovoid- to lance-ellipsoid, 6–13 (15) mm. long, 2.1–5 mm. in diameter, gently incurved, obtuse at base, contracted distally into a triangular, rigidly long-cuspidate beak, somewhat laterally compressed, bicarinate by the prominent, thickened sutures, the middle of the valves transversely dilated into a longitudinal, strongly convex ridge, the green or red-mottled, glabrous or nearly glabrous valves becoming stiffly papery, stramineous or brownish, ± lustrous, transversely reticulate, thinly filamentous within; *dehiscence* apical, through the beak, and ultimately through the ventral suture; *ovules* 11–14; *seeds* pale ocher-brown, ± pitted, 1.8–2.1 mm. long.—Collections: 12 (iv); representative: *E. & L. Payson 1694* (NY, RM); *C. L. Porter 7754* (RM);



Map No. 27. Southwestern Wyoming, northwestern Colorado, and northeastern Utah. Range of ◗ *A. drabelliformis*; of ◆ *A. simplicifolius*; and of ◢ *A. detritalis*.

Ripley & Barneby 7744, 9147 (CAS, RSA), *8916* (CAS, NY, RM, RSA, UTC).

Windswept hilltops, barren ridges, and along the tops of gullied bluffs, on shale, sandstone, or in crevices of limestone pavement, 5400–7250 feet, local but forming colonies, known only from valleys of the upper North Platte and Wind Rivers in Natrona, Carbon, and Fremont Counties, Wyoming.—Map No. 27.—May to August.

ASTRAGALUS SIMPLICIFOLIUS (Nutt.) Gray in Proc. Amer. Acad. 6: 231. 1864, based on *Phaca simplicifolia* (simple-leaved) Nutt. ex T. & G., Fl. N. Amer. 1: 350. 1838.—"Summits of high hills of the Rocky Mountain range, towards the sources of the Platte."—Holotypus, labeled by Nuttall "*Phaca *simplicifolia.* R. Mts./Platte," BM! isotypi, GH (fragm.), NY, PH!—*Tragacantha simplicifolia* (Nutt.) O. Kze., Rev. Gen. 948. 1891. *Homalobus simplicifolius* (Nutt.) Rydb. in Bull. Torr. Club 40: 52. 1913.

Astragalus lingulatus (tongue-shaped, of the phyllodia) Sheld. in Minn. Bot. Stud. 1: 118. 1894.—"Collected at the foot of the Big Horn mts., Wyoming, August, 1859; also on Red Buttes on North Platte river, Wyoming, May, 1860, by Mr. F. V. Hayden on the expedition of Capt. W. F. Raynolds, U.S.A., to the headwaters of the Missouri and Yellowstone rivers."—Lectotypus, collected at Red Buttes, Natrona County, Wyoming, May 10, 1860, MO! Paratypus, from the Big Horn Mountains, MO!, is sterile and although marked *type* by Sheldon is best disregarded; it may represent *A. spatulatus.*—*Homalobus lingulatus* (Sheld.) Rydb. in Bull. Torr. Club 40: 52. 1913.

Astragalus exilifolius (thin-leaved) A. Nels. in Bull. Torr. Club 26: 10. 1898.—"Type specimen, No. 4493, by Mr. Elias Nelson, Freezeout Hills, Carbon County, July 10, 1898."—Holotypus, RM! isotypi, GH, MO, NY, US!

The delightful little bun milk-vetch, *A. simplicifolius,* closely resembles the more condensed phases of *A. spatulatus* in habit of growth and superficial appearance. The two species grow in the same situations and have often been confused, although there is no need for this if either flowers or fruits are present. The substantially larger flower and its prominently five-nerved and glabrescent calyx are characteristic of *A. simplicifolius;* and although the fruit is fashioned after the same basic pattern as that of *A. spatulatus,* its faces are much more strongly distended laterally into prominent obtuse ridges, extending lengthwise nearly from the base up to the triangular beak. The pod might be likened to that of some *Pectinati* on a much reduced scale; on this account the species was referred originally by Nuttall to *Phaca* rather than to *Homalobus,* of which the generic character is a strongly flattened, two-sided fruit. The species varies a good deal in vigor from year to year, and perhaps from one population to another. The type-series of *A. exilifolius* has relatively large flowers and pods, and leaves longer than ordinary, but is essentially typical of its kind.

The bun milk-vetch is known certainly from a quite limited area in the Platte Valley between Casper and Rawlins, and from one apparently disjunct station on the upper Wind River near Dubois. The paratypus (MO) of *A. lingulatus* from the Big Horn Mountains possibly indicates a range-extension northward, but the specimen was collected in August and is now sterile except for a fragmentary calyx; it may well represent *A. spatulatus,* common in that region. A doubtful record (Barneby, 1947, p. 9) from Cañon City, Colorado, was also based on a specimen without flowers or fruits, but a duplicate (*Brandegee,* UC) examined since then has finely developed pods, identifying it as *A. spatulatus.*

71. ASTRAGALUS DETRITALIS

Dwarf, caespitose, the shortly forking caudex beset with remains of stipules and leaf-bases, the herbage densely silvery-strigulose or -strigose with fine, straight, appressed, parallel and subcontiguous hairs up to (0.5) 0.6–1.2 mm. long; *stems* of the year mostly reduced to rosulate crowns, together forming depressed tufts up to 15 cm. in diameter, or some of them a little developed and up to 3 cm. long, but the internodes very short, not surpassing and usually concealed by stipules; *stipules* 3–10 mm. long, scarious with green or at length brownish midrib, amplexicaul and connate through half their length or more into a sheath, glabrous or early glabrescent dorsally, the ovate or lanceolate free blades ciliate; *leaves* dimorphic, the lowest in the year's cycle 0.5–2 cm. long, mostly reduced to a narrowly oblanceolate or linear-oblanceolate phyllodium not differentiated into petiole and blade, rarely all or nearly all palmately trifoliolate, the upper ones (1)

2-8 cm. long, with wiry petioles and 1–3 pairs of linear-lanceolate or -oblanceolate, or subfiliform, very acute, rather stiff and dorsally carinate, ± involute leaflets (0.3) 0.5–3 cm. long, all jointed to the rachis, sometimes obscurely so; *peduncles* scapose, erect or incurved-ascending, 1–7 (9) cm. long, either ascending or decumbent in fruit; *racemes* shortly 2–6 (8)-flowered, the flowers strongly ascending, the axis 0.2–2.6 (3.8) cm. long in fruit; *bracts* scarious with green, finally pallid midrib, ovate-acuminate or broadly lanceolate, boat-shaped, (2.5) 3–7 mm. long, glabrous or nearly so; *pedicels* ascending or erect, at anthesis 0.5–1.4 mm., in fruit 1.2–2.5 mm. long; *bracteoles* usually 0, rarely present and up to 2.5 mm. long; *calyx* at anthesis (5.1) 5.8–9.2 (9.6) mm. long, strigulose with white and sometimes a few black hairs, the symmetric disc 0.7–1.3 mm. deep, the submembranous, purplish tube 3.1–5.2 (5.4) mm. long, 2.5–4.1 mm. in diameter, the narrowly subulate, rather stiff, erect or up-curved teeth (1.6) 2–4.5 (4.7) mm. long, the ventral pair often shortest, the orifice oblique, the whole becoming papery and a little distended or accrescent, persisting usually unruptured; *petals* pink-purple, the banner pale-eyed, striate; *banner* recurved through ± 45°, oval-elliptic to broadly rhombic-oblong, openly notched, (12) 13.5–18 (20) mm. long, 5.5–8.5 (9.8) mm. wide; *wings* a little shorter to a trifle longer, (10.8) 12.5–16.3 (19.7) mm. long, the claws (4.4) 4.6–6.5 mm., the lanceolate or lance-elliptic, obtuse and sometimes obscurely erose blades (7.7) 8–12 (14.2) mm. long, 2–3.4 mm. wide, the left one more strongly incurved than the right and its blade infolded; *keel* (8.4) 9.4–12.8 (13.4) mm. long, the claws (4.1) 4.5–6.3 (6.8) mm., the half-obovate blades 5.2–7.3 (8.1) mm. long, 2.5–3.2 (3.7) mm. wide, gently incurved through 85–95° to the rounded or bluntly deltoid apex; *anthers* (0.5) 0.55–0.9 mm. long; *pod* erect or narrowly ascending, sessile, tardily if at all disjointing from the receptacle, linear-oblong, straight or a little incurved, 1.5–3.5 (3.8) cm. long, 2–3.5 mm. in diameter, obtuse at base, cuspidate at apex, strongly compressed and 2-sided, carinate ventrally by the slender but salient suture, narrowly rounded dorsally, the lateral faces shallowly concave along the ventral suture and low-convex toward the dorsal one, the thinly fleshy, greenish and usually red-mottled, finely strigulose valves becoming papery, stramineous, finely cross-reticulate; *ovules* (15) 16–24; *seeds* brown, rugulose, ± 2–2.4 long.—Collections: 10 (viii); representative: *Ripley & Barneby 4669, 4687* (CAS, RSA), *7786* (CAS, RSA, UTC); *Barneby 12,705* (CAS, NY, RSA), *12,710* (CAS, NY, RSA), *12,732* (COLO, RSA).

Cobblestone bluffs, barren knolls, hilltops, and gullied badlands, on shale, sandstone, or stony alluvial clays, 5200–7000 feet, local but forming colonies in scattered stations within the Uinta Basin in Duchesne and Uintah Counties, Utah, and Rio Blanco County, Colorado.—Map. No. 27.—May to June.

ASTRAGALUS DETRITALIS (of rock debris) Jones, Contrib. West. Bot. 13: 9. 1910.—"Four miles above Theodore on the Colton road . . . ," i.e., s.-w. of Duchesne, Duchesne County, Utah.—Holotypus, collected by Jones May 11, 1908, at 6000 ft. elevation, POM! isotypi, G, GH, NY!—*Homalobus detritalis* (Jones) Rydb., Fl. Rocky Mts. 1063. 1917.

Astragalus spectabilis (handsome) C. L. Porter in Rhodora 54: 160. 1952.—"TYPE: *C. L. Porter 5309* . . . in a canyon about 5 miles south of Vernal, Uintah County, Utah, June 3, 1950 . . . "—Holotypus, RM! isotypi, CAS, GH, MO, SMU, TEX!—Non *A. spectabilis* Schischk., 1929.

The debris milk-vetch, *A. detritalis,* is most abundant on the white shales exposed around the southern periphery of the Uinta Basin, where it is commonly associated with *Lesquerella subumbellata* Roll. in open stands of Utah juniper. The astragalus and the lesquerella flower simultaneously, and the bright golden cushions of the little crucifer, intermingled with low tufts of carmine vetch and an occasional patch of *Penstemon dolius* Jones, are set off to brilliant advantage by the pale chalky background of the barrens. Eastward, along the Rio Blanco in Colorado, *A. detritalis* has been found on sandstone outcrops and among rock debris under

sandstone cliffs, but the plants are smaller, less floriferous, and occur in small, scattered stands. On the soft red clay of gullied badlands near Vernal, where the species is represented by the unusually vigorous, large-flowered form described as *A. spectabilis,* it is associated with four Basin endemics, *A. Hamiltoni, Cymopterus duchesnensis* Jones, *Hermidium alipes* var. *pallidum* C. L. Port., and *Cordylanthus uintahensis* Penn.

Reduction of at least the early leaves to phyllodia, a feature of sect. *Drabellae,* is less extreme in some populations of *A. detritalis* than in its kindred. In some plants from populations growing between 6000 and 7000 feet, the lowest leaves, although always shorter than the later ones, are mostly and in a few cases all composed of three leaflets, and these are jointed to the rachis. However some phyllodia have been found in every colony of the species. The presence in all plants of some 3–7 foliolate leaves and the occasional absence of leaves reduced to a simple blade might suggest that *A. detritalis* is primitive in relation to the remaining *Drabellae*; but its greatly elongated pod and large flowers seem, in their context, specialized.

The flowers of the debris milk-vetch vary in size from one population to the next, as well as from plant to plant in colonies of limited extent, but the whole range of variation has not been seen in any one place. The smallest flowers, with banner 12–13.5 mm. long, came from barren shale hilltops at 7000 feet near the head of Pariette Wash in Duchesne County; the largest, with banner 16–20 mm. long, from protected gullies in the badlands of Asphalt Ridge, at about 5300 feet in Uintah County (= *A. spectabilis*). At other stations the banner (and other petals proportionately) varies from 13.5–16 mm. (Duchesne), to 14.5–16 mm. (Meeker, Colorado), and 15.5–17 mm. (southwest of Myton, Utah). Isolation of colonies has apparently permitted or encouraged slightly different ranges of variation in each; but with no evidence of an overlapping sequence and the pod varying little or not at all, it is clear that *A. spectabilis* is no more than a minor variant.

XIV. Sectio SOLITARII

Slender, caulescent perennials, the stems arising from a ± deeply buried, determinate root-crown (not seen in *A. Applegatii*); *vesture* basifixed; *stipules* free; *leaves* imparipinnate, the leaflets 5–21; *flowers* racemose, declined in age, very small, the banner ± 6.5–8 mm. long, abruptly recurved; *calyx-tube* shallowly campanulate, the teeth short; *petals* whitish tinged or veined with lilac, little or sometimes irregularly graduated, the wings sometimes a trifle shorter than the keel or longer than the banner, the keel-tip obtuse or subacute; *pod* declined or pendulous, tardily deciduous with the disjointing pedicel, stipitate, the laterally flattened, unilocular body linear-oblong or -elliptic in profile, varying from straight to gently incurved, decurved, or coiled; *dehiscence* tardy, imperfectly known, but apparently sometimes apical and sometimes upward through the stipe; *ovules* 6–16. —Spp. 3, 2 xerophytes, 1 mesophyte, rare and local in southeastern and south-central Oregon and extreme northern Nevada.

ASTRAGALUS sect. SOLITARII, sect. nov., *Collinos* et praesertim *Camptopodes* spectantes, sed floribus minimis, calycis tubo breviter campanulato minime tumido basi subsymmetrico necnon vexillo obovato-cuneato abrupte recurvo absimiles.—Sp. typica: *A. solitarius* Peck.

The *Solitarii* form a group apparently coordinate with and more or less closely related to the last four sections. Their principal features are the tiny flowers composed of a shallowly campanulate, shortly toothed calyx and an abruptly recurved banner not much longer than the wings or keel, and the stipitate, laterally flattened pod of papery texture. A subterranean root-crown is characteristic of *A. solitarius* and *A. alvordensis,* both xerophytic species of the arid southeastern corner of Oregon; the root is unfortunately not known in *A. Applegatii,* a meadow-dwelling astragalus apparently endemic to the upper Klamath River. The one member of the section known to Jones (1923, p. 141) and Rydberg (1929, p. 279) was associated by them with *A. (Podosclerocarpi) speirocarpus,* an arrangement suggested by the spiral curvature of the fruit. Peck compared *A. solitarius* with *A. filipes,* again on the basis of a similiarity in fruit-structure, and failed to appreciate the likeness in the fine detail of the flowers, stipules, and the habit of growth upon which sect. *Solitarii* derives its foundation as a natural group.

Key to the Species of Sect. Solitarii

1. Stems mostly 1.5–3 dm. long; *leaflets* 11–21, obovate-obcordate, 1–7 mm. long; *body* of the pod spirally coiled or at least hamately incurved, the valves villosulous ..... 72. *A. alvordensis*

1. Stems (2) 3–5 dm. long; *leaflets* 5–11, linear or linear-elliptic, 3–20 mm. long; *body* of the pod straight or falcately decurved, strigulose (2)
   2. Peduncles 5–15 cm. long, mostly surpassing the leaf; *keel* 6.3–7.4 mm. long (nearly equaling the banner), the blades broadly sickle-shaped, triangular and subacute at tip; *body* of the pod 12–25 mm. long, the almost flat faces 3–4 (5) mm. wide; xerophyte of arid sagebrush country in s. Malheur County ..... 73. *A. solitarius*
   2. Peduncles 3–6 cm. long, about equaling the leaf; *keel* 5.5–5.9 mm. long (1–1.5 mm. shorter than the banner), the blades half-obovate, obtusely deltoid-triangular at tip; *body* of the pod 8–11 mm. long, the low-convex faces 2.4–2.8 mm. wide; mesophyte of the upper Klamath Valley, Klamath County ..... 74. *A. Applegatii*

72. Astragalus alvordensis

Slender, wiry, cinereous throughout with twisted and incumbent hairs up to 0.2–0.5 mm. long, the leaflets sometimes more thinly pubescent and greenish above; *stems* 1.5–3 dm. long, arising singly or few together from the thickened but scarcely caudiciform root-crown 3–10 cm. below soil-level, simple and naked at base, upon emergence freely and divaricately branching, the branches disposed in the same plane, thus forming flattened sprays of triangular-rhombic outline; *stipules* 0.5–2.5 mm. long, the lowest papery-scarious, decurrent around ± ⅔ the stem's circumference, the median and upper ones herbaceous, deltoid-ovate; *leaves* widely spreading or deflexed, (1) 1.5–5 cm. long, with (7) 11–21 narrowly or broadly obovate and retuse, or obcordate, flat or conduplicate leaflets 1–7 mm. long; *peduncles* divaricate, commonly disposed to hang below the subtending leaf, 1–3.5 cm. long; *racemes* loosely 5–14-flowered; *bracts* 0.5–1 mm. long; *pedicels* slender, at anthesis about 1 mm., in fruit straight and ascending, or arched outward, up to 2 mm. long; *bracteoles* 0; *calyx* 2.5–3 mm. long, villosulous with incurved, white and often partly black hairs, the disc ± 0.6 mm. deep, the campanulate tube 2–2.5 mm. long, 2 mm. in diameter, the deltoid or narrowly triangular teeth 0.5–0.7 mm. long, the whole becoming papery, marcescent unruptured; *petals* pale lilac, or whitish to yellowish veined and suffused with lilac, the keel-tip commonly purplish; *banner* abruptly recurved through 90°, obovate-cuneate, emarginate, 7–8.2 mm. long, 4.4–4.8 mm. wide; *wings* (slightly longer or shorter) 6.5–7.2 mm. long, the claws 2.2–2.7 mm., the narrowly obovate, obtuse, lunately incurved blades 4.5–5.2 mm. long, 1.8–2.2 (2.5) mm. wide; *keel* 4.6–5.3 mm. long, the claws 2.2–2.7 mm., the almost half-circular blades 2.5–3 mm. long, 2.1–2.3 mm. wide, incurved through 120° to the bluntly deltoid, sometimes obscurely porrect apex; *anthers* 0.35–0.45 mm. long; *pod* loosely pendulous, stipitate, the stipe 2–9 mm. long, gradually expanded upward into the narrowly oblong, abruptly acute or shortly acuminate body 3–4 mm. wide, this variable in length and curvature, either strongly hamate or commonly coiled through 1½–2 spirals, strongly compressed, bicarinate by the salient but slender sutures, the thin, pale green, villosulous valves becoming papery, stramineous, delicately reticulate, not inflexed; *dehiscence* tardy, apparently both apical and upward through the stipe, after falling; *ovules* 10–16; *seeds* (not seen fully ripe) about 2 mm. long.—Collections: 8 (i); representative: *Peck 21,778* (CAS, ID, NY), *24,317* (WILLU), *25,604* (CAS, RSA); *Ripley & Barneby 6164* (CAS, GH, NY, RSA); *W. H. Baker 1750* (ID).

Barren knolls, bluffs, and desert hillsides, in loose sandy soils of volcanic origin, rare and local on and near the Owyhee-Quinn River divide in southern Harney and Malheur Counties, Oregon, and extreme northern Humboldt County, Nevada.—Map No. 28.—May to July.

Astragalus alvordensis (of Alvord Ranch) Jones, Contrib. West. Bot. 10: 67. 1902 (*"Alvordensis"*).—"No. 2583, Cusick, gathered in the desert of Alvord Valley, eastern Oregon,

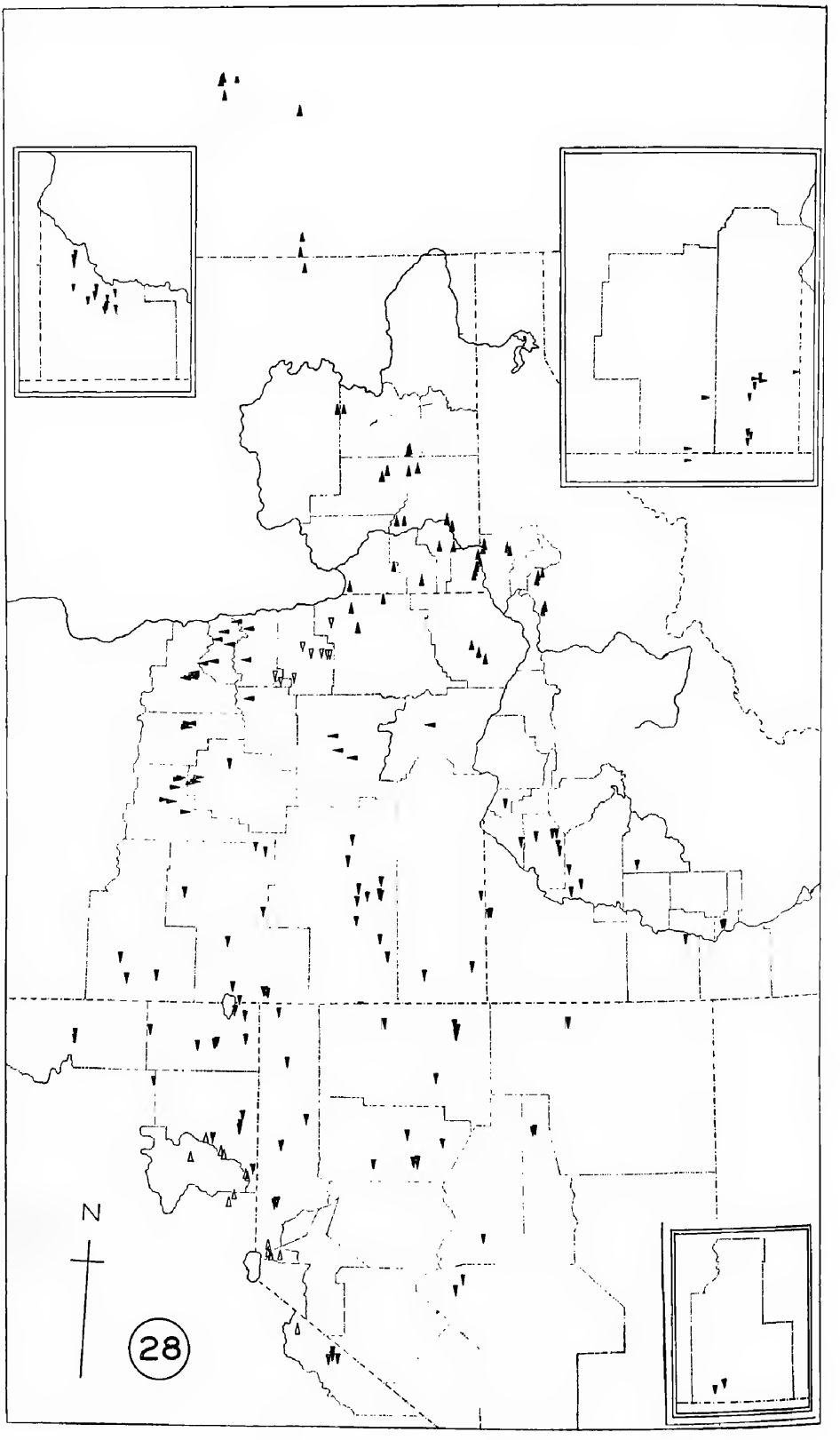
June 18, 1901."—Holotypus, POM! isotypi, G, GH, K, ND, NY, MO, ORE, P, POM, US!—*Homalobus alvordensis* (Jones) Rydb. in Bull. Torr. Club 51: 18. 1924 *("alvordiensis").*

The Alvord milk-vetch is a modest astragalus, but in every fine detail a remarkable one. The subterranean root-crown and divaricate branching of the stems suggest the growth-habit of some *Scytocarpi,* but the free stipules and laterally flattened pod are of a quite different type. The combination of small, distant, obovate-obcordate leaflets, tiny, lilac-veined flowers, and pods pendulous from beneath the leaves on stipes usually longer than the calyx is unique in the genus. The pod is variable in length and curvature, usually coiled through more than one complete turn upon itself, but sometimes, when short, no more than strongly hooked. It is similar in form and texture to that of *A. camptopus* of the following section, a species easily distinguished by its cordlike stolons and much larger flowers of a vivid purple shade. The flower of *A. alvordensis* resembles that of the other *Solitarii* in almost all respects, but the keel is shorter in relation to the banner and more abruptly and further incurved into a broader and blunter tip.

73. Astragalus solitarius

Slender, wiry, rather tall, sparsely leafy, with a shortly buried root-crown or caudex, cinereous nearly throughout with appressed and incumbent hairs up to ± 0.3 mm. long, the leaflets pubescent on both sides, rarely glabrescent and greenish above; *stems* few or solitary, (2) 3–4.5 dm. long, leafless at base, divaricately branching upward or more rarely simple, flexuous distally; *stipules* 1–2 (3) mm. long, the lowest adnate to a suppressed petiole to form a semiamplexicaul, papery sheath, the rest herbaceous, deltoid or triangular, sometimes reflexed; *leaves* 2–7 cm. long, with 5–9 remote, opposite or scattered, linear or linear-oblong, obtuse or subacute leaflets 3–15 mm. long; *peduncles* divaricate and incurved-ascending, (3) 5–15 cm. long; *racemes* loosely or remotely (3) 7–30-flowered, the axis (1.5) 4–25 cm. long in fruit; *bracts* subulate, 0.6–1.5 mm. long; *pedicels* at anthesis ± 1 mm. long, becoming 1.5–2 mm. long and usually abruptly deflexed in fruit; *bracteoles* 0; *calyx* 2.6–3.2 mm. long, strigulose with white or partly (the teeth especially) black hairs, the campanulate tube 2.3–2.8 mm. long, 1.2–1.8 mm. in diameter, the deltoid or subulate teeth 0.3–0.8 mm. long, the whole becoming papery, marcescent unruptured; *petals* pale lilac, drying ochroleucous; *banner* abruptly recurved through 90°, obovate-cuneate, emarginate, 6.3–8 mm. long, 4.7–5 mm. wide; *wings* (as long or slightly longer) 7–8.1 mm. long, the claws 2.8–3.5 mm., the oblong-oblanceolate, obtuse or obscurely emarginate, gently incurved blades 4.2–5 mm. long, 1.5–2 mm. wide; *keel* little shorter than the banner, 6.3–7.4 mm. long, the claws 2.8–3.5 mm., the broadly sickle-shaped blades 3.5–4.2 mm. long, 1.8–2.1 mm. wide, incurved through less than 90° to the narrowly triangular, subacute apex; *anthers* 0.45–0.5 mm. long; *pod* pendulous, stipitate, the slender stipe 4–8 mm. long, the body narrowly oblong or lance-oblong in profile, 1.2–2.5 cm. long, 3–4 (5) mm. in diameter, bent downward from its junction with the stipe and thereafter either straight or falcately decurved, cuneate or acuminate at either end, strongly compressed, bicarinate by the filiform sutures, the thin, pale green but often faintly purple-mottled valves becoming stramineous and papery, rather densely strigulose with incurved hairs, not inflexed; *dehiscence* apparently both apical and upward through the stipe; *ovules* (6) 8–14; *seeds* (not seen quite ripe) brown, apparently smooth, ± 2.4 mm. long.—Collections: 8 (ii); representative: *Peck 25,686* (CAS, RSA, WILLU, WS), *25,725* (CAS, RSA, WILLU), *25,753* (RSA, WILLU); *Ripley & Barneby 9397* (CAS, RSA, UTC, WILLU).

Plains and low gullied hills, in sandy clay soils, nearly always taking shelter under and often intricately entangled in low sagebrush, exceptionally in open places (when dwarfed and erect), 3800–4600 feet, local and apparently nowhere abundant, upper forks of the Owyhee River and on the divide immediately to the south in southern Malheur County, Oregon.—Map No. 28.—May to early July.


N
28

ASTRAGALUS SOLITARIUS (solitary, apparently of the single or at best few stems) Peck in Leafl. West. Bot. 4: 181. 1945.—"Type: *Peck No. 21726,* among sagebrush, 15 miles north of McDermitt, Malheur County, Oregon, June 4, 1943."—Holotypus, WILLU! isotypi, NY, RSA!

The solitary milk-vetch is one of the most interesting astragali discovered in America in recent years. It was likened by Peck to *A. filipes,* which has a similarly stipitate and laterally flattened pod, but the free stipules and the proportions of the flower-parts are quite different. The flexuous stems unusually tall for their diameter, the few narrow leaflets, and the tiny, distantly disposed flowers create a strong impression of individuality, and *A. solitarius* is unlikely to be confused with any other species. The body of the pod is remarkable in being set at a downwardly directed angle from its junction with the stipe; thereafter it varies from straight to gently decurved.

The nearest relative of the solitary milk-vetch is *A. Applegatii,* a weaker, greener plant distinguished principally by its much shorter and narrower pod. Along the Owyhee River near Rome the ranges of *A. solitarius* and the related *A. alvordensis* overlap, but the two species are sharply separated ecologically. The latter is found only on bluffs and knolls where the soil is deep, soft, and porous, and the plants form colonies in open places fully exposed to sun and wind. By contrast *A. solitarius* occurs on stiff clays of the valley-floors and mesas, the plants being scattered and hard to find; the vigorous specimens always grow up in concealment through bushes of *Artemisia arbuscula,* from which they are most difficult to extract unbroken. The rare plants found in open ground are stunted and often sterile, and symbiosis with sagebrush seems to be characteristic of the species. Possibly the seeds require shelter for germination, or the seedlings may need protection during their early growth. Astragali of several sections (cf. *A. atratus* or *A. pinonis*) have become adapted to the same biotic relationship.

74. ASTRAGALUS APPLEGATII

Slender, diffuse, caulescent, doubtless perennial but the root and base of the stems unknown, thinly strigulose with appressed hairs up to 0.25–0.4 mm. long, the herbage green, the leaflets glabrous above; *stems* about 3–4 dm. long, possibly longer, bearing spurs or slender branches at 2–5 nodes preceding the first peduncle, floriferous from 3–7 nodes above the middle; *stipules* 1.5–3 mm. long, those at the lower, leafless nodes early becoming papery, strongly adnate to the suppressed petiole and almost fully amplexicaul but free, the median and upper ones herbaceous, deltoid or triangular-acuminate, mostly deflexed; *leaves* 3.5–7 cm. long, petioled but the uppermost very shortly so, with 7–11 linear or linear-elliptic, obtuse but mucronulate, flat leaflets (5) 8–20 mm. long, the terminal one usually the longest; *peduncles* incurved-ascending, 3–6 cm. long; *racemes* loosely or at length remotely 10–18-flowered, the flowers early spreading and ultimately declined, the axis elongating, 3–7 cm. long in fruit; *bracts* membranous, triangular-ovate, 1–1.5 mm. long; *pedicels* very slender, at anthesis ± 1.3 mm., in fruit scarcely thickened, spreading or ascending, 1.5–2 mm. long, persistent or perhaps tardily disjointing with the fruit; *bracteoles* 0; *calyx* 3–3.3 mm. long, strigulose with black and partly white or fuscous hairs, the subsymmetric disc 0.7–0.9 mm. deep, the campanulate tube 2.3–2.5 mm. long, 1.8–2 mm. in diameter, the triangular to broadly subulate teeth 0.7–0.9 mm. long, the whole becoming papery, marcescent unruptured; *petals* whitish, the banner and keel-tip faintly lilac-tinged; *banner* abruptly recurved through 85–90°, rhombic-ovate-cuneate, openly notched, 6.5–7 mm. long, 4.6–5 mm. wide; *wings* (a trifle longer or shorter than the keel) 5.3–6.2 mm. long, the claws 2–2.2 mm., the narrowly oblong-elliptic or -oblanceolate, subtruncate,

---

Map No. 28. Parts of the Columbia and Great Basins, transmontane Washington and Oregon with portions of adjoining states. Range of *A. collinus*: ◠ var. *collinus*; and ◡ var. *Laurentii*; of *A. curvicarpus*: ◥ var. *curvicarpus*; ◗ var. *brachycodon*; and ◖ var. *subglaber*; and of ◠ *A. Gibbsii*. Inset, top left, Owyhee County, Idaho. Range of *A. camptopus*. Inset, top right, Harney and Malheur Counties, Oregon. Range of ◗ *A. alvordensis*; and ◥ *A. solitarius*. Inset, lower right, Klamath County, Oregon. Range of *A. Applegatii*.

slightly incurved blades 3.5–4.4 mm. long, 1.2–1.5 mm. wide; *keel* 5.5–5.9 mm. long, the claws 2.2–2.4 mm., the half-obovate blades 3.5–4 mm. long, 1.9–2 mm. wide, abruptly incurved through ± 90° to the bluntly deltoid apex; *anthers* 0.35–0.5 mm. long; *pod* widely spreading or declined, stipitate, the straight, slender stipe 4–5 mm. long, the narrowly and subsymmetrically oblong-ellipsoid body 8–11 mm. long, 2.4–2.8 mm. in diameter, straight or nearly so, narrowly cuneate-acuminate at base, contracted abruptly at apex into a minute cusp, laterally compressed and 2-sided, the faces low-convex, the sutures slender but salient, the thin, green or faintly purple-speckled or –mottled, minutely strigulose valves becoming stramineous, smooth or nearly so, not inflexed; *dehiscence* apparently apical and then downward through the ventral suture; *ovules* 8–10; *seeds* dark brown, minutely punctate, 2.1–2.5 mm. long.—Collections 2 (o), cited below.

Meadows and moist ground along wayside ditches, about 4100 feet, apparently rare and local, known only from southwestern Klamath County, Oregon (Klamath Falls; Keno), to be sought in adjoining Siskiyou County, California.—Map No. 28.—June to early August.

ASTRAGALUS APPLEGATII (Elmer Ivan Applegate, 1867–) Peck in Proc. Biol. Soc. Wash. 49: 111. 1936.—"Type *M. E. Peck* 16784, moist roadside near Keno, Klamath Co., Oregon, July 10, 1931. *M. E. Peck* 15119, damp meadow near Klamath Falls, Oregon, June 22, 1927, is the same."—Holotypus, from "2 miles east of Keno" in "1932," WILLU! Paratypus *(Peck 15,119),* WILLU!

Although we have yet to learn about some systematically important features of the Applegate milk-vetch, in particular the position of the root-crown or caudex and the nature of the lowest pairs of stipules, it is reasonable to suppose that it will be found to resemble *A. solitarius* in these respects, for the general aspect and fruit-structure of the two species are alike and the flowers are almost identical, except that the keel-tip of *A. Applegatii* is less strongly porrect and blunter. The shorter body of the pod with its narrower and more convexly distended faces is immediately diagnostic of *A. Applegatii,* but the plant seems also to be weaker than *A. solitarius,* with more diffuse or trailing stems, shorter peduncles, and a fruit dehiscent primarily at apex rather than baso-ventrally and through the stipe. Adaptation to a moist habitat is probably an acquired characteristic, for the other *Solitarii* and all their nearer relatives are pronounced xerophytes. Only one other mesophytic astragalus, *A. Lemmoni,* is known to occur along the Klamath River in Oregon or adjoining California; it also has tiny flowers, but these are arranged in short, crowded racemes on peduncles paired in all or most axils, and its pod is sessile, fully bilocular, and grooved along the back.

XV. Sectio CAMPTOPODES

Caulescent perennials of moderate stature, the stems arising singly or few together from buds on slender, deeply buried, horizontally creeping rhizomes; *vesture* besifixed; *stipules* free; *leaves* imparipinnate, with 13–21 leaflets; *flowers* racemose, spreading, of medium size, the banner 14–16.5 mm. long, recurved through ± 45°; *calyx-tube* campanulate, somewhat tumid; *petals* pink-purple, regularly graduated, the keel-tip obtuse; *pod* widely spreading or declined, stipitate, tardily deciduous with the pedicel, the body laterally flattened, coiled into a ring, the valves stiffly papery, not inflexed; *dehiscence* both apical and basal, through beak and stipe; *ovules* 20–22.—Sp. 1, xerophyte, of sagebrush desert along the lower Bruneau and adjoining Snake Rivers in southwestern Idaho.

ASTRAGALUS sect. CAMPTOPODES, sect. nov., inter sect. *Collinos* et *Solitarios* quasi intermedii, ab eis floribus patulis purpureis et legumine chartaceo, ab his floribus multo majoribus et calyce tumescenti absimiles, ab omnibus utriusque sectionis speciebus habitu rhizomatoso late repenti insignes. Sp. unica: *A. camptopus* Barneby.

By all reasonable standards of comparison *A. camptopus* stands out from the crowd as a remarkable astragalus. The majority of isolated monotypes in the genus have become so greatly modified that their origin and affinities remain open to arbitrary and often controversial interpretations. There can be no question, however, as to the relationship of

A. camptopus to some individual members of sects. *Collini* and *Solitarii,* and perhaps more remotely to *A. speirocarpus* of sect. *Podosclerocarpi.* From all of these, however, *A. camptopus* differs in its stoloniferous habit of growth, by means of which a single plant may form a clonal association many feet across. Its flower is suggestive of that of sect. *Collini,* especially in the tumescent calyx, but this is less obliquely attached to the pedicel, neither basally gibbous nor reflexed early in anthesis, and the petals are purple, not white or yellowish. The stipitate, annular pod is similar to that of *A. speirocarpus* in compression and curvature but of much thinner texture than in any *Podosclerocarpi* or *Collini;* it is more nearly comparable to that of *A. alvordensis* in sect. *Solitarii,* a group of three rare species which inhabit the same general region as *A. camptopus.* The *Solitarii* are distinguished by their tiny flowers, shallowly campanulate calyces, and by the abruptly reflexed banner.

75. Astragalus camptopus

Colonial perennial, from an initial taproot with subterranean crown giving rise to slender rhizomes, from which in turn stems originate singly or few together at irregular intervals, the herbage loosely strigulose or villosulous with incumbent or curly hairs, commonly canescent throughout, or the leaflets sometimes more thinly pubescent and greenish above; *stems* erect or ascending, 2–3 dm. long, leafless and buried for 2–10 cm., becoming stouter and leafy on emergence, simple or few-branched near the middle, the short upper internodes abruptly flexuous or zigzag; *stipules* 1–3 mm. long, the lowest adnate to a suppressed petiole to form a loose, scarious, semiamplexicaul, bidentate sheath, the median and upper ones deltoid or ovate, herbaceous, cauline; *leaves* spreading, 3–8 cm. long, with (9) 13–21 obovate-cuneate, obtuse or commonly retuse, sometimes obcordate, flat or loosely folded leaflets 4–12 mm. long; *peduncles* erect or divaricately ascending, 1–6.5 cm. long; *racemes* rather loosely 9–15-flowered, the flowers ascending or subhorizontal at full anthesis, the axis becoming 3–8 cm. long in fruit; *bracts* ovate, acute, ± 1 mm. long; *pedicels* ascending, at anthesis 1–1.5 mm., in fruit a trifle thickened, ± 2 mm. long; *bracetoles* 0; *calyx* 5–6.5 mm. long, thinly villosulous with pale or dark hairs, the oblique disc nearly 1 mm. deep, the campanulate, membranous, often purplish, somewhat inflated tube 5–6 mm. long, 3.6–4 mm. in diameter, the deltoid teeth 0.5–0.9 mm. long, the ventral pair broadest, the whole becoming papery, marcescent unruptured; *petals* bright pink-purple; *banner* ovate-cuneate, 14–17 mm. long, 8.5–10 mm. wide; *wings* 14–16.5 mm. long, the claws 7–8 mm., the broadly lanceolate, slightly incurved blades 7–8 mm. long, 2.8–3 mm. wide; *keel* 12–13 mm. long, the claws 7–7.5 mm., the half-obovate blades 5–6 mm. long, ± 3 mm. wide, incurved through nearly 90° to the blunt apex; *anthers* 0.6–0.65 mm. long; *pod* stipitate, the stipe 1–1.5 cm. long, spreading subhorizontally at base and thereafter arched downward or somewhat contorted distally, gradually expanded at apex into the narrowly oblong body, this 3.5–4 mm. wide, coiled through 1½–2 spirals into a closed ring, strongly compressed laterally, bicarinate by the slender but salient sutures, the dorsal suture often undulate, the scarcely fleshy, pale green, sometimes mottled valves becoming stiffly papery, stramineous, cross-reticulate, thinly villous with spreading or incurved hairs up to 0.7–1 mm. long, not inflexed; *seeds* (seldom seen) brown, ± 2 mm. long.—Collections: 14 (iii); representative: *Jones 25,420* (CAS, DS, MO, POM, WTU); *Maguire & Holmgren 26,220* (BM, CAS, NY, RSA, TEX, UTC, WS), *26,351* (CAS, NY, UTC, WS); *W. H. Baker 10,104, 10,217* (ID, RSA).

Barren knolls, gulches in the foothills, sagebrush scablands, dunes and dunelike hillsides, in loose sandy soils of basaltic or rhyolitic origin, 2300–3300 feet, locally plentiful and forming colonies, known only from the lower Bruneau Valley and from creeks flowing north into the Snake River below its confluence with the Bruneau in Owyhee County, Idaho.—Map No. 28.—May and June.

Astragalus camptopus, (with bent foot, of the curved stipe) Barneby in Leafl. West.

Bot. 4: 228. 1946.—"IDAHO: . . . 5 miles southwest of Bruneau, Owyhee Co., alt. 2500 ft., 2 June, 1945, fl. & fr., *Ripley & Barneby No. 6525* . . ."—Holotypus, CAS! isotypi, GH, ID, K, NY, PH, POM, RSA, UTC!

The Bruneau milk-vetch, *A. camptopus,* is an ornamental astragalus which in good years clothes the barren, sandy hillsides and low, rhyolitic knolls of the Bruneau Desert with wide patches of ashen foliage, beset in May and early June with abundant pink-purple blossoms. The rhizomatous growth-habit and commonly broad, retuse leaflets are reminiscent of *A. (Uliginosi) oreganus,* although the flowers and fruits are very different in detail. The pods, when first formed, are pale green, often mottled with reddish-purple, and are borne on slender, decurving stipes which are often sigmoidally or more elaborately contorted. The body of the fruit is nearly always coiled into a complete circle or through two spirals flattened against each other in the manner of a split ring, but an occasional exceptionally short pod may be no more than hamately incurved.

The species was discovered in 1930 by Marcus Jones, who referred it tentatively both to *A. speirocarpus* and to *A. sinuatus,* under which name his excellent material (*No. 25,420,* cited above) was widely distributed. (cf. Jones, Contrib. West. Bot. 17: 16, 29. 1930). The established range of the Bruneau milk-vetch scarcely exceeds fifty miles east and west, but in its area it is common and locally abundant.

XVI. Sectio COLLINI

Caulescent perennials, relatively robust, with shallowly buried or superficial root-crown or knotty, short-forking caudex; *vesture* basifixed, commonly villosulous; *stipules* free, or the lowest connate (in *A. Gibbsii*); *leaves* imparipinnate, with ± 9–21 (25) articulate leaflets; *flowers* racemose, nodding at full anthesis, often loosely retrorse-imbricated, of moderate size, the banner ± 12–21 mm. long; *calyx-tube* broadly campanulate to broadly cylindric, usually somewhat tumid, strongly oblique in profile, either gibbous-saccate behind the pedicel, or truncate at base and the pedicel attached at the lower corner; *petals* white, ochroleucous, or pale yellow, regularly graduated, or the blade of the banner shortened, replicate distally and shorter than the wings, the keel shortest, obtuse; *pod* pendulous or horizontally spreading, stipitate, tardily deciduous together with the disjointing pedicel, the laterally compressed body bicarinate by the thick, salient sutures, straight, variably incurved, or coiled, the ± fleshy valves becoming stiffly papery or almost woody, not inflexed; *dehiscence* tardy, apical and basal (upward through the stipe), after falling; *ovules* (7) 9–30 (34).—Spp. 3, xerophytes, of the Great and Columbia Basins, eastcentral and northeastern California to southwestern and westcentral Idaho, north through Oregon and Washington to southern British Columbia, there reaching the lower Thompson River.

ASTRAGALUS sect. COLLINI Jones, Rev. Astrag. 139. 1923.—Sp. typica: *A. collinus* Dougl.
Homalobus sect. *Collini* Rydb., Fl. Rocky Mts. 509, in clave, sine descr. 1917, & in Bull. Torr. Club 51: 13. 1924.—Sp. typica: *H. collinus* (Dougl.) Rydb. = *A. collinus* Dougl.

The homonymous sections proposed by Jones and Rydberg are equivalent in content, but they seem to have been described independently and therefore are listed above in separated paragraphs. The section is restricted in these pages to the three astragali which, in common with *A. collinus,* have declined flowers, a tumescent, basally gibbous-saccate (or in small-flowered populations, basally truncate) calyx resembling that of *Cuphea,* and a pendulous, bicarinate pod tardily disjointing with the pedicel and dehiscent on the ground through both beak and stipe. The scope of the section might have been enlarged to include the clearly related *A. Tweedyi,* which has similar flowers, but these, like the pods, are erect-ascending and the pods themselves persist on the raceme and dehisce through the gaping beak alone. Of other species admitted to sect. *Collini* by Jones, Rydberg, or both, *A. speirocarpus* and *A. sclerocarpus* form, together with *A. sinuatus,* a related group distinguished by a narrower, basally subsymmetric calyx and ascending flowers; while the tiny-flowered *A. alvordensis* has been transferred to a new sect. *Solitarii,* characterized by flowers of quite different proportions and a fruit of papery texture.

The affinities of sect. *Collini* can be traced in two directions: on the one hand to sect. *Podosclerocarpi* and, in varying degrees of remoteness, to the four sections next in order

below; and on the other to sect. *Hookeriani,* one member of which, *A. californicus,* was described in the first place as a variety of *A. collinus* and poses a problem of much theoretical interest. Rydberg (1924, p. 14) believed *A. collinus* and *A. californicus* to be close kindred and remarked with some asperity on the fact that Jones (1923) had placed them in different sections in the genus, separated in his monograph by over seventy pages of text. Both judgements are reasonable, but it seems more convenient to follow Jones in associating *A. californicus* with *A. filipes* of sect. *Hookeriani,* for they are alike in the important features of connate lower stipules, campanulate calyx obliquely rounded but not saccate at base, and pod of relatively thin texture. It must be noted, however, that *A. Gibbsii,* the flower of which is the most highly modified and characteristic of the three *Collini,* also has connate stipules, a fact which throws an aura of doubt over the systematic value of this criterion, however useful it may prove in practice. It can hardly be doubted that *A. californicus* represents a link between two major series of sections, of which the mostly free-stipuled *Collini, Lonchocarpi,* and *Podosclerocarpi,* on the one hand, and the connate-stipuled *Hookeriani, Genistoidei* (independently linked to *Lonchocarpi*), and *Scytocarpi,* on the other, may fairly be considered as forming the nuclei. As so often happens in genera which display a reticulate pattern of relationships between component groups of species, it is impossible to arrange the members in a linear sequence expressive of affinity in more than one direction. Here, as in Jones's Revision, *A. collinus* and *A. californicus* are artificially separated.

The species of sect. *Collini* are much alike in flower, and fully formed fruits are ordinarily required for identification. The almost perfectly disjunct ranges, however, provide in most cases a short road to identifying young material.

Key to the Species of Sect. Collini

1. Reticulation of the pod impressed, the intervals between the nerves somewhat elevated; n.-e. Oregon (Wallowa, Umatilla, Morrow and s.-e. Gilliam Counties) and w.-centr. Idaho, n. through e. Washington to s. British Columbia.....76. *A. collinus*
1. Reticulation of the pod elevated above the intervals; Deschutes and John Day river-systems in e.-centr. Oregon, s. to the Snake River Plains in s. Idaho, to centr. Nevada, and n.-e. and e.-centr. California (2)
   2. Stems loosely strigulose with subappressed or incurved hairs; widespread in the range given .....77. *A. curvicarpus*
   2. Stems densely villosulous with subhorizontally spreading or retrorse hairs; e. base of Sierra Nevada from s. Lassen to Mono County, California, and immediately adjoining Nevada .....78. *A. Gibbsii*

76. Astragalus collinus

Robust or sometimes quite slender, villosulous nearly throughout with fine, ascending, incurved, sinuous, or curly hairs up to 0.3–0.55 mm. long, the herbage cinereous or greenish, the leaflets commonly pubescent on both sides, sometimes thinly so or (rarely) glabrous above; *stems* several or numerous, decumbent, diffusely ascending, or nearly erect, 1.5–4 (5) dm. long, together forming low, well-furnished clumps, commonly slender and leafless at base, stouter upward, composed of ± 4–7 (11) developed internodes, spurred or branched at 1 or more nodes at and below the middle; *stipules* 2–5 (7) mm. long, the lowest early becoming papery, decurrent around ± half the stem, the median and upper ones narrower, with lanceolate or triangular-acuminate, erect or deflexed, herbaceous blades; *leaves* 3–9 (10.5) cm. long, shortly petioled or the uppermost subsessile, with (9) 11–21 (25) oblong-oblanceolate, narrowly obovate-cuneate, or linear-elliptic, nearly always truncate-retuse but occasionally obtuse, flat leaflets 4–20 (22) mm. long; *peduncles* erect or incurved-ascending, (4) 5–16 cm. long, equaling or commonly surpassing the leaf; *racemes* (10) 15–40 (55)-flowered, rather dense at early anthesis, the nodding flowers then retrosely imbricated, becoming looser in age, the axis (3) 4–12 (18) cm. long in fruit; *bracts* submembranous, ovate, lanceolate, or lance-acuminate, 1.5–3.5 mm. long; *pedicels* slender, ascending, at anthesis straight or nearly so, 0.8–2 mm. long, in fruit a trifle thickened, 1.5–2.8 mm. long; *bracteoles* commonly 2, rarely vestigial or 0; *calyx* 7–12.3 mm. long, villosulous or subtomentulose with white or some black hairs, the strongly

oblique disc (0.8) 1–1.7 (2) mm. deep, the membranous, pallid, ovoid-campanulate or broadly cylindric tube 5.8–9.4 mm. long, (3.2) 3.7–5.7 mm. in diameter, straight or nearly so on the dorsal side, strongly convex on the ventral side and gibbous-saccate at base, the broadly lanceolate, triangular-subulate, or deltoid teeth (0.8) 1–2.7 (3.5) mm. long, the ventral pair broadest but either longer or shorter than the rest, the whole becoming papery, marcescent unruptured; *petals* cream-colored or pale lemon-yellow, the blade of the banner and the auricles of the wings and keel sometimes fleshy-thickened; *banner* (10.5) 12–17.2 mm. long, sigmoidally arched, the long-cuneate claw incurved proximally to conform with the calyx, the broadly oval, rhombic-ovate, or suborbicular, notched blade very abruptly and strongly folded back around the margins and 5–8.6 mm. wide, the blade exceptionally better developed and rhombic-oblanceolate, then recurved through ±50°; *wings* (10.5) 11–15.7 mm. long, the claws (5.3) 6–8.2 mm., the obovate or broadly oblanceolate, obtuse or subemarginate, nearly straight blades (5.1) 5.4–9 mm. long, 2.1–3.3 mm. wide; *keel* 8.7–13.2 mm. long, the claws (5.3) 6–8.8 mm., the obtusely triangular blades (3.7) 4–5.5 mm. long, 2.2–3.5 mm. wide, abruptly incurved through ± 90° to the bluntly deltoid apex; *anthers* (0.4) 0.5–0.75 (0.9) mm. long; *pod* pendulous, stipitate, the straight, slender stipe 5–15 mm. long, the body linear- or narrowly lance-oblong in profile, or in one var. obliquely ovate-oblong to lunate-oblong, straight or gently incurved, 0.7–2.5 cm. long, 2.3–4.2 mm. in diameter, cuneate at both ends, shortly cuspidate at apex, strongly compressed, bicarinate by the thickened, salient sutures, the lateral faces low-convex toward the dorsal suture, the somewhat fleshy, greenish valves becoming stramineous, leathery, impressed-reticulate, not inflexed; *ovules* 7–18; *seeds* (seldom seen) brown or olivaceous, smooth or pitted, dull ± 2.5 mm. long.

Key to the Varieties of A. collinus

1. Pod slenderly linear-oblong in profile, 0.7–2.5 cm. long, 2.5–3.4 (4) mm. in diameter, straight or rarely a little incurved, the valves villosulous or loosely strigulose with hairs up to 0.25–0.5 mm. long; *ovules* (10) 12–18; s. British Columbia s. through e. Washington to w.-centr. Idaho and adjoining Oregon (w. to Umatilla County) ..... 76a. var. *collinus*
1. Pod plumper and averaging shorter, obliquely ovate-oblong in profile, gently incurved, 0.8–1.5 cm. long, 3.3–4.2 mm. in diameter, typically villosulous with hairs up to 0.5–1 mm. long, exceptionally glabrous; *ovules* (7) 8–12; Morrow and adjoining Umatilla and Gilliam Counties, Oregon ..... 76b. var. *Laurentii*

76a. Astragalus collinus var. collinus

Stipe of the pod (5) 6–15 mm. long; otherwise as given in the key.—Collections: 50 (ii); representative: *J. R. Anderson 116, 854* (WS); *Hitchcock & Muhlick 8330* (CAS, NY, WS, WTU); *Sandberg & Leiberg 196* (CAS, NY, WS); *J. W. Thompson 11,668* (CAS, NY, RSA, SMU, WS, WTU); *Cronquist 6510* (CAS, ID, NY, SMU, TEX, WS).

Bunchgrass prairies, grassy hillsides, and sagebrush valleys, in light sandy or stony soils overlying basalt, 900–3100 feet, forming colonies and locally abundant in central and southeastern transmontane Washington, extending southeast along the Snake River and its affluents from the south into westcentral Idaho and the north foothills of the Wallowa and Blue Mountains in Oregon, westward into Umatilla County; also apparently isolated on the upper Okanogan and lower Thompson Rivers in southern British Columbia.—Map No. 28.—May to July.

Astragalus collinus (Hook.) Don, Gen. Hist. Dichl. Pl. 2: 256. 1832, published independently of but exactly synonymous with *Phaca collina* (dwelling on hills) Hook., Fl. Bor.-Amer. 1: 141. 1831.—"On the subalpine range of the Blue Mountains, in dry soils . . . *Douglas*."

—Holotypus, from "undulating and hilly grounds w. of the Rocky Mountains, in dry soils.," K! isotypi, BM, OXF!—Don's specimen, formerly in herb. Lambert. (?), not located; he gives the locality as "North America, on the banks of the Columbia River."—*Tragacantha collina* (Hook.) O. Kze., Rev. Gen. 944. 1891. *Homalobus collinus* (Hook.) Rydb. in Bull. Torr. Club 40: 53. 1913.

Astragalus cyrtoides (convex, of the calyx, "bossed on the upper side like that of a *Cuphea*") Gray in Proc. Amer. Acad. 6: 201. 1864. "Clear Water River, interior of Oregon (now in Washington Territory [at present Idaho]), in rich land on hillsides, April 14, Rev. Mr. Spalding."—Holotypus, GH!

Within its area of dispersal the hill milk-vetch, *A. collinus,* is easily recognized by its greatly modified flower, remarkable for the tumid, basally pouched calyx of nearly the same color as the creamy petals, and for the relatively short, sigmoidally arched banner. The body of the pod is ordinarily straight, but is sometimes a trifle arched upward or downward. A noteworthy collection from Idaho County, Idaho, (*Constance 1847,* WS, WTU) combines a rather long, gently incurved pod with a developed banner, its limb recurved through about 50° rather than abruptly folded back a little below the apex. This may possibly represent a distinct race cut off from the main area of the species by the deeply dissected topography of the Salmon River canyon, but for the present too little evidence is available on which to base an opinion.

76b. Astragalus collinus var. Laurentii

Stipe of the pod (3.5) 5–10 mm. long; otherwise as given in the key.—Collections: 11 (iii); representative: *Ripley & Barneby 10,783* (CAS, NY, POM, RSA, WILLU, WS, WTU, WYO); *Head 596* (RSA).

Dry grassy hills and hilltops, in sandy or stony clay soils derived from basalt, locally abundant and forming colonies, 2900–3600 feet, about the headwaters of Rock, Willow, and Butter Creeks in Morrow County, Thirty-mile Creek in extreme southeastern Gilliam County, and at about 2000 feet in the lower Umatilla Valley in northwestern Umatilla County, Oregon.—Map. No. 28.—May to July.

Astragalus collinus var. Laurentii (Rydb.) Barneby in Amer. Midl. Nat. 55: 487. 1956, based on *Homalobus Laurentii* (William Evans Lawrence, 1871-1950, botanist from 1910 onward at Oregon State College) Rydb. in Bull. Torr. Club 51: 15. 1924.—"Type collected east of Heppner [err. "Heffner"], Oregon, *W. E. Lawrence 744.*"—Holotypus, collected 17 July, 1917, NY! isotypi, RSA (with more exact data: "at head of Hinton Creek, 13½ miles e. of Heppner, 3128–3375 ft." (comm. S. Conrade Head ex herb. Ore. State Coll.), US!—*Astragalus Laurentii* (Rydb.) Peck, Man. Pl. Ore. 443. 1940, & in Madroño 6: 134. 1941.

The typus of the Lawrence milk-vetch and the collections cited as representative originated at points a few miles apart along the road from Heppner to Lena, and probably consist of random examples from one large population. There is only one other record, from the Umatilla Valley near Echo, of exactly typical var. *Laurentii (Schallig S190, RSA).* In the strict sense the variety differs from var. *collinus* only in the relatively short and broad, gently incurved, few-ovulate pod beset with longer spreading hairs, but the modification is a striking one. North of Heppner, along upper Rock Creek (where first collected by Leiberg, *No. 66,* NY) in the southwest corner of Morrow County, and extending west to Thirty-mile Creek in adjoining Gilliam County, *A. collinus* is represented by a form with pods similar to that of var. *Laurentii* but averaging a little longer and entirely glabrous. I have suggested (1956, p. 487) that these plants may have come into being as a result of introgression between var. *Laurentii* and the closely related *A. curvicarpus* var. *subglaber,* which reaches its eastern limit along the lower John Day River in Gilliam County. However, the copious vesture of the herbage and the impressed reticulation of the pod-valves are characteristic of *A. collinus,* and the plants occur in extensive and uniform populations which are certainly self-perpetuating. For the present the glabrous-fruiting form is interpreted as a minor variant of var. *Laurentii.*

77. Astragalus curvicarpus

Commonly robust and leafy, sometimes quite slender, with several or many decumbent or diffusely ascending stems arising from the knotty root-crown or shortly forking caudex at or just below soil-level, the herbage varying from loosely strigulose to villosulous with curly, incumbent, or sometimes appressed hairs up

to 0.25–0.5 mm. long, in one var. nearly glabrous, in consequence varying from cinereous to deep green, the leaflets ± bicolored, yellow-green above; *stems* 1.5–4 (5) dm. long, leafless at base, simple or commonly branched or spurred at 1–several nodes preceding the first peduncle, flexuous or zigzag distally; *stipules* (1) 1.5–5 mm. long, the lowest scarious or early becoming so, decurrent around a little more than half the stem's circumference, the median and upper ones herbaceous, mostly narrower, with deltoid or triangular-lanceolate, commonly reflexed blades; *leaves* 2.5–9 cm. long, all but the lowest subsessile, with ascending or sometimes divaricate rachis and (7) 9–19 (21) obovate-cuneate, oblong-obovate, or -elliptic, or broadly oblanceolate, retuse or truncate, more rarely elliptic-oblanceolate and obtuse, flat or loosely folded leaflets 3–18 (23) mm. long; *peduncles* erect or arcuate-erect, 4–15 cm. long, nearly always surpassing the leaf; *racemes* (5) 10–25 (35)-flowered, loose at full anthesis, the flowers nodding, the axis 2–10 (13) cm. long in fruit; *bracts* membranous or membranous-margined, ovate-acuminate, or lance-subulate, 0.7–2.5 mm. long; *pedicels* slender, at anthesis ascending, 1–2.2 mm. long, in fruit either ascending or a little arched outward, or sometimes straight and divaricate, 1.4–3.5 mm. long; *bracteoles* usually 0, minute when present; *calyx* 6.1–13.6 mm. long, villosulous or strigulose with white or black hairs, the disc set at an angle to the tube, the pallid, membranous, somewhat tumid tube deeply and broadly campanulate to broadly cylindric, straight or slightly concave dorsally, strongly convex ventrally and gibbous-saccate or truncate behind the pedicel, the triangular to broadly deltoid teeth 0.4–2.3 mm. long, the ventral pair broadest, but either longer or shorter than the rest, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, clear white, or lemon-yellow; *banner* 13.6–21 mm. long, rhombic-oblanceolate or -ovate, tapering downward into a long claw curved conformably with the calyx, the blade commonly recurved through ± 45°, in one var. poorly developed and abruptly folded back distally as in *A. collinus; wings* a little shorter (longer) than the banner, the oblong-oblanceolate or -obovate, obtuse blades nearly straight to gently incurved; *keel* 9.4–15.2 mm. long, the half-obovate blades incurved through 85–100° to the bluntly deltoid apex; *anthers* 0.5–0.9 mm. long; *pod* pendulous (from horizontal peduncles vertically divaricate), stipitate, the straight, slender stipe 6–20 mm. long, the narrowly oblong body 1.4–3.5 cm. long, 2.7–4.5 mm. in diameter, crescentic, falcate, hamate, or more rarely coiled through 1½ spirals, cuneate or cuneately tapering at base, cuspidate at apex, strongly compressed, bicarinate by the salient, cordlike sutures, the lateral faces low-convex toward the dorsal edge, the somewhat fleshy, green or purple-spotted valves becoming brownish-stramineous, stiffly papery or thinly leathery, prominently cross-reticulate, villosulous or glabrous, not inflexed; *dehiscence* of the section, the sutures tending to separate from the valves in age; *ovules* 14–25 (28); *seeds* drab or olivaceous, smooth but dull, (2) 2.3–3.8 mm. long.

The sickle milk-vetch, *A. curvicarpus,* is a coarse but rather handsome astragalus, readily recognized by its nearly always broad truncate or retuse leaflets, nodding white to lemon-yellow flowers with basally pouched calyx, and stipitate, laterally flattened, usually much-incurved pods. Over the greater part of its range in the Great Basin it varies little; however, along the streams flowing north to the Columbia River in northcentral Oregon, it has given rise to two usually well-differentiated but marginally intergradient geographic races, differing in details of the vesture and flowers.

The name *A. Whitedii,* a synonym of *A. sinuatus,* a local species found only in eastern Washington well to the north of *A. curvicarpus,* was applied to this species for several decades (Barneby, 1956, p. 486) and is still current in some modern floras.

Key to the Varieties of A. curvicarpus

1. Ovary and pod (at least the stipe) pubescent or if (exceptionally) the pod glabrous

then the *flowers* large, the keel over 12 mm. long, combined with *leaflets* pubescent on both sides; Nevada and e. California to s.-w. Idaho, extending n. in Oregon to the foothills of the Blue Mountain system but not beyond ..... 77a. var. *curvicarpus*

1. Ovary and pod glabrous; either the *flowers* small, with keel mostly less than 12 mm. long, or the *leaflets* glabrous above; n.-w. transmontane Oregon, in the drainage of the John Day and Deschutes Rivers (2)
   2. Flowers small, the calyx 6.1–8.5 (9.3) mm. long, 2.9–3.5 mm. in diameter, the keel 9.4–11.6 (12.3) mm. long; *leaflets* at least thinly pubescent above; upper Deschutes River in Deschutes, Jefferson and Crook Counties ..... 77b. var. *brachycodon*
   2. Flowers large, the calyx tumescent or inflated, (8) 9–13.6 mm. long, (4) 4.5–5.8 mm. in diameter, the keel 11.5–14.5 mm. long; *leaflets* glabrous above, thinly ciliate; lower Deschutes and John Day Valleys in Wasco, Sherman, Gilliam, Wheeler and Grant Counties ..... 77c. var. *subglaber*

77a. ASTRAGALUS CURVICARPUS var. CURVICARPUS

Usually stout, less often low and slender, the stems 1.5–4 dm. long; *herbage* loosely strigulose to villosulous with incurved, curly, or spreading hairs up to 0.25–0.5 mm. long, usually densely so, cinereous or sometimes greenish, the leaflets always, even if only thinly, pubescent above; *calyx* (7.9) 9.1–11.2 mm. long, the disc 1–1.4 mm. deep, the tube (6.9) 7.5–9.7 mm., long, (3.2) 3.9–4.8 mm. in diameter, the teeth (0.5) 1–2.3 mm. long; *banner* (15) 16.4–21 mm. long, the well-developed blade (5.6) 6–10.2 mm. wide, recurved through ± 45°; *wings* (14) 15–20.6 mm. long, the claws 7.6–10.7 mm., the blades 7–11.2 mm. long, 2.4–3.4 mm. wide; *keel* (11) 11.7–15.2 mm. long, the claws (7.4) 7.8–9.6 mm., the blades 4.9–6.2 mm. long, 2.7–3.3 mm. wide; *stipe* of the pod (9) 11–20 mm. long, the *body* 2–3.5 cm. long, (2.7) 3–4.1 (5.5) mm. in diameter, hamately incurved or coiled into a ring, villosulous or incumbent-strigulose, exceptionally glabrate in age, very rarely glabrous; *ovules* 18–25 (28); *seeds* 2.9–3.8 mm. long. —Collections: 86 (xiii); representative: *Maguire & Holmgren 26,452* (NY, RSA, UTC, WS); *Hitchcock & Muhlick 8630* (NY, WS, WTU); *M. & G. Ownbey 2772* (CAS, NY, RSA, SMU, WS), *2817* (CAS, NA, NY, RSA, SMU, TEX, WS); *Barneby 11,504* (CAS, NY, POM, RSA); *Wiggins & Rollins 573* (CAS, TEX, WS); *W. E. Lawrence 5231* (RSA, WS).

Sagebrush plains and foothills, in loose sandy or gravelly soils overlying basalt or granitic formations, sometimes forming extensive colonies on stabilized dunes, widespread and locally plentiful at (2750) 3100–6200 feet, from Honey Lake and the upper Klamath Basin in northern California eastward across transmontane Oregon to the Snake River Plains in southwestern Idaho, south across northern and westcentral Nevada, especially in the Humboldt and Reese River Valleys, to the east slope of the Sierra Nevada in Mono County, California, there ascending along the Walker River to 9200 feet.—Map No. 28.—Mid-April to July.

ASTRAGALUS CURVICARPUS (A. Hell.) Macbr. in Contrib. Gray Herb., New Ser. 65: 38. 1922, based on *Homalobus curvicarpus* (with curved pod) A. Hell., Muhlenbergia 2: 86. 1905, best treated as an independent new proposition because of the illegitimacy of the basionym *A. speirocarpus* var. *curvicarpus* Sheld. in Minn. Bot. Stud. 1: 125. 1894, a superfluous substitute for *A. speirocarpus* var. *falciformis* (sickle-shaped) Gray ap. Brew & Wats., Bot. Calif. 1: 152. 1876.—"Sierra Co. *(Lemmon)* and adjacent mountains of Nevada *(Watson)*."—Holotypus, *Lemmon 621* in 1874, GH! istotypus, K! paratypi, *Watson 282*, from the Toyabe and Pah-Ute Mountains, GH, NY, US!—Non *A. falciformis* Desf., 1799.—*A. Gibbsii* var. *falciformis* (Gray) Jones, Contrib. West. Bot. 8: 23. 1898. *A. Gibbsii* var. *curvicarpus* (Sheld.) Jones, op. cit. **10**: 62. 1902, an illegitimate substitute.

Astragalus Whitedii fma. *speirocarpoides* (like *A. speirocarpus* in the coiled pod) Barneby in Proc. Calif. Acad. Sci. IV, **25**: 148, Pl. 17, fig. 31. 1949.—"NEVADA: . . . 10 miles north of Winnemucca, Humboldt Co. . . . *Ripley & Barneby 4552* . . ."—Holotypus, collected May 23, 1942, CAS! isotypus, RSA!

The pod of *A. curvicarpus* is variable in curvature, most often bent inward into the form of a hook or sickle but sometimes crescentic. A pod coiled into a ring or even further, through one and a half spirals (= fma. *speirocarpoides*) is common in Lake County, Oregon, and in northwest Nevada, and has given rise in the past to records of *A. speirocarpus* from these areas. Occasional specimens combining either the small flowers of var. *brachycodon* with the pubescent fruit of var. *curvicarpus* (e.g., *Cronquist 7845*, from Lake County, Oregon, NY, RSA) or the characteristic large flowers of var. *curvicarpus* with the hairless fruits of var. *subglaber* (e.g., *J. T. Howell 12,226*, from Shasta County, California, CAS) are on record, but are interpreted as minor independent variants rather than as directly intergradient with the northern varieties of the species. The differential characters of the closely related *A. Gibbsii*, distributed along a peripheral segment of the range of *A. curvicarpus*, are mentioned under that heading.

77b. Astragalus curvicarpus var. brachycodon

Similar to var. *curvicarpus*, the stems usually slender, 2–4 dm. long, the herbage strigulose with appressed, or loose and incurved, sometimes flattened hairs up to 0.25–0.4 mm. long, the leaflets pubescent on both sides but sometimes thinly so above; *leaflets* (9) 13–19 (21), 3–11 (15) mm. long; *pedicels* at anthesis 1–1.5 mm., in fruit 1.4–2.3 mm. long; *calyx* 6.1–8.5 (9.3) mm. long, the disc 0.9–1.3 mm. deep, the deeply campanulate or rarely cylindric tube 5.4–7.6 (8.6) mm. long, 2.9–3.5 (4.1) mm. in diameter, the teeth 0.4–1 mm. long; *banner* rhombic-oblanceolate, 13.6–15 (16.8) mm. long, 5.4–8.2 mm. wide, recurved through ± 45°; *wings* 11.5–14.2 (15.2) mm. long, the claws 5.5–7.4 (8.8) mm., the blades 6.4–8.1 mm. long, 2.3–3.3 mm. wide; *keel* 9.4–11.6 (12.3) mm. long, the claws 5.3–7 (7.9) mm., the blades 4.4–5.6 mm. long, 2.6–3.3 mm. wide; *stipe* of the pod 6–12 (15) mm. long, the *body* 1.4–2.2 cm. long, 3–4 (4.5) mm. wide, lunately incurved or hamate, glabrous; *ovules* 15–21; *seeds* (2) 2.3–3.1 mm. long. —Collections: 11 (i); representative: *Kruckeberg 2134* (CAS, ID, IDS, NY, WS); *Whited 221* (OB, WS); *C. L. Hitchcock 19,417* (ID, NY, WS); *Cronquist 7179* (NY, RSA, some pods pubescent, transition to var. *curvicarpus*).

Plains and hillsides, in rough basaltic gravel or pumice sand, 2800–3800 feet, locally plentiful on the upper forks of the Deschutes River in Crook, Jefferson, and Deschutes Counties, Oregon.—Map No. 28.—May to July.

Astragalus curvicarpus var. brachycodon (Barneby) Barneby in Amer. Midl. Nat. **55**: 487. 1956, based on *A. Whitedii* var. *brachycodon* (short-belled, of the calyx) Barneby in op. cit. **41**: 496. 1949.—"Oregon: ... three miles north of Redmond, Deschutes Co., 2 July, 1942, *M. E. Peck No. 21491*."—Holotypus, WILLU! isotypus (fragm.), RSA!

The var. *brachycodon* is geographically intermediate between var. *curvicarpus* and var. *subglaber* and also morphologically so to the extent that it combines the relatively copious leaf-pubescence of the former with the (nearly always) glabrous pod of the latter. It differs from both in the smaller flowers, which are subject to some variation in length, and the largest slightly overlap the measurements recorded for var. *curvicarpus*. The blade of the banner is ordinarily well developed, as in var. *curvicarpus*, and not both shortened and abruptly replicate distally as is usual in var. *subglaber* and the closely related *A. collinus*. The calyx of the smallest flowers of var. *brachycodon* is scarcely tumid and obscurely saccate at base, sometimes only abruptly truncate, with the pedicel attached at right angles to the lower corner.

77c. Astragalus curvicarpus var. subglaber

Resembling slender-stemmed forms of var. *curvicarpus*, but very thinly pubescent, the stems glabrous or nearly so, the leaflets bearing a few scattered, appressed or ascending hairs up to 0.3–0.5 mm. long on the margins and dorsal midrib, the herbage dark green; *stems* 2–4 dm. long; *calyx* (8) 9–13.6 mm. long, sparsely strigulose or villosulous, the disc 1–1.7 mm. deep, the tube (7.6) 8–11.9 mm. long, (4) 4.5–5.8 mm. in diameter, the teeth 0.5–2.3 mm. long; *banner* 13.5–19.5 mm. long, either rhombic-oblanceolate with well-developed blade recurved through ± 45°, or more commonly broadly oblanceolate-flabellate, with shortened

and distally replicate blade, this often fleshy-thickened at the middle; *wings* ± equaling the banner, 14.7–18.1 mm. long, the claws 7.5–10 mm., the obovate or oblanceolate blades 7.1–10.2 mm. long, 2.8–3.5 mm. wide; *keel* 11.5–14.5 mm. long, the claws 7–9.5 mm., the blades 4.8–6.5 mm. long, 3–3.5 mm. wide, the auricles (as often of the wings also) often fleshy-thickened; *stipe* of the pod 10–15 mm. long, the *body* 1.6–2.3 cm. long, 3–4 mm. in diameter, gently incurved or sometimes hamate, glabrous; *ovules* 14–20; *seeds* (little known) ± 3.8 mm. long. —Collections: 19 (ii); representative: *Cronquist 6214* (CAS, ID, NY, OKLA, SMU, WS), *6226* (CAS, ID, NY, SMU, TEX, WS); *Maguire & Holmgren 26,631* (NY, RSA, UTC, WS); *Ripley & Barneby 10,827* (CAS, NY, RM, RSA, WILLU).

Dry rocky hillsides, rough prairies, and gravelly sagebrush slopes and flats, on basalt, 1800–3000 (3900) feet, locally plentiful in the valleys of the John Day and lower Deschutes Rivers, from Wasco to Gilliam, south to northern Jefferson, Wheeler, and central Grant Counties, Oregon.—Map No. 28.—Late April to early July.

ASTRAGALUS CURVICARPUS var. SUBGLABER (Rydb.) Barneby in Amer. Midl. Nat. **55**: 487. 1956, based on *Homalobus subglaber* (nearly glabrous) Rydb. in Bull. Torr. Club **51**: 17. 1924.—"Type collected on John Day River, Oregon, May 11, 1882, *Thomas J.* [err. *I*] *Howell* . . . "—Holotypus, collected May 10, 1882, near the mouth of John Day River, NY! isotypus, US! probable isotypus, dated May 10, 1882, but labeled "Antelope," ORE! Howell spms. at G, GH, P, WS, WTU dated "1880" are nevertheless probably isotypi.—*A. collinus* var. *subglaber* Gray ex Rydb., in syn. *A. subglaber* (Rydb.) Peck, Man. Pl. Ore. 444. 1940 & in Madroño **6**: 134. 1941.

At a casual glance the stems and rich dark green foliage of var. *subglaber* appear naked of hairs, but a rudimentary vesture is nearly always to be found along the margins and midribs of the leaflets. The individual flower is strikingly modified, the calyx being decidedly tumid and saccate at base, while the sigmoidally arched banner is ordinarily short by comparison with the wings and abruptly replicate distally. A fleshy thickening of the banner-blade leaves a characteristic brown spot in drying; and the auricles of the wings and keel are similarly succulent, becoming pyriform when restored by soaking.

Mention has already been made of a glabrous-fruiting form of *A. collinus* var. *Laurentii* which occurs at points a few miles east of the known range-limit of var. *subglaber* in Morrow County, and this is bound to suggest a passage between the vicariant *A. curvicarpus* and *A. collinus*. The elevated reticulation of the fruit in *A. curvicarpus* provides the most easily observed difference between the two species, and it is clear that the closer affinity of var. *subglaber* lies in the direction of var. *brachycodon*. These two varieties of the sickle milk-vetch have been found close together along the Deschutes River in Jefferson County, but no doubt has yet arisen as to the identity of any specimen.

78. ASTRAGALUS GIBBSII

Rather stout and leafy, with a shortly subterranean, knotty root-crown or caudex, villosulous nearly throughout with fine hairs up to 0.5–0.8 mm. long, those of the stems and petioles mostly straight and horizontally spreading, those of the leaves sometimes similar but as often incumbent and curly, the herbage canescent or rarely greenish-cinereous, the leaflets pubescent on both sides but often more thinly so above, the upper face paler green than the lower; *stems* numerous, decumbent or prostrate, 1.5–3.5 dm. long, naked and slender at base, becoming stouter and flexuous distally, simple or commonly spurred at 1–4 nodes preceding the first peduncle; *stipules* 1.5–5 mm. long, dimorphic, those at the lowest nodes small, scarious, fully amplexicaul and connate into a cup- or collar-like sheath, the median and upper ones herbaceous, ± semiamplexicaul-decurrent, free, with triangular or triangular-lanceolate blades; *leaves* (1.5) 3–9.5 cm. long, spreading or recurved, the lowest shortly petioled, the uppermost subsessile, with (7) 11–19 broadly or narrowly cuneate, obovate-cuneate, or more rarely oblanceolate, retuse, flat or

loosely folded leaflets 4–20 mm. long; *peduncles* rather stout, incurved-ascending, 3–10 (12.5) cm. long, either shorter or longer than the leaf; *racemes* 10–30-flowered, dense at early anthesis, the flowers early nodding and retrorsely imbricated, becoming looser, the axis elongating, 2.5–10 cm. long in fruit; *bracts* submembranous, ovate or broadly lanceolate, 1.3–3 (4.5) mm. long; *pedicels* (densely villous) erect or ascending, straight or nearly so, at anthesis 1.5–2.2 mm., in fruit little thickened, 2.7–4.3 mm. long; *bracteoles* 2, triangular or setaceous; *calyx* 9.5–12.3 mm. long, villosulous or villous-tomentulose with white and sometimes a few fuscous or black hairs, the strongly oblique disc 1.3–1.7 mm. deep, the broadly and deeply campanulate, ovoid-campanulate, or subcylindric tube 7.6–9.8 mm. long, 4–5.5 mm. in diameter, convexly arched dorsally and gibbous behind the pedicle, the broadly subulate, lance-triangular, or deltoid teeth 2.3–3.7 mm. long, the ventral pair commonly longest and always broadest, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* dull yellow, the banner somewhat fleshy-thickened in the fold; *banner* sigmoidally arched, 14–17 (18) mm. long, the long-cuneate, tapering claw incurved proximally to conform with the curve of the calyx, abruptly expanded into an ovate, transversely oval, or suborbicular, openly notched, strongly recurved or reflexed blade 7–9.2 mm. wide; *wings* as long to 1.7 mm. longer than the banner, 14–18.3 mm. long, the claws 7.5–10.3 mm., the obliquely obovate or broadly lance-oblong, obtuse or undulate-emarginate blades 7.5–9.1 mm. long, 3–4.3 mm. wide; *keel* 12–15 mm. long, the claws 7–9.7 mm., the half-obovate blades 5.3–6.4 mm. long, 3.2–3.6 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid apex; *anthers* 0.6–0.8 (0.85) mm. long; *pod* essentially pendulous but sometimes humistrate and then apparently ascending, stipitate, the straight, slender or upwardly thickened stipe (7) 10–22 mm. long, the lunately or falcately oblong, narrowly oblong-ellipsoid, or linear-oblong body 2.2–3 cm. long, (4) 4.5–8 mm. in diameter, incurved through ± ¼–½-circle, cuneate or cuneately tapering at base, abruptly contracted distally and cuspidate at apex, laterally compressed, bicarinate by the salient, thickened, often narrowly winged ventral and thinner but often undulate dorsal sutures, the lateral faces transversely distended and convex at maturity, the fleshy, green or purple-mottled valves becoming stramineous, stiffly leathery, reticulate, rather densely villosulous with spreading or incumbent hairs, not inflexed; *ovules* 18–30 (34); *seeds* (little known) brown, sometimes purple-speckled, sparsely pitted, dull, 2.3–2.7 mm. long.—Collections: 17 (iii); representative: *Jones 3829* (CAS, NY, POM); *E. K. Balls 14,825, 15,949* (CAS, RSA); *Ripley & Barneby 4541, 5951* (CAS, RSA); *A. Heller 9817* (CAS); *Heller & Kennedy 8868* (CAS, NY).

Sagebrush valleys, silty meadow flats, and openings in yellow pine forest, in dry sandy or sandy clay soils mostly of volcanic origin, 4150–6000 feet, locally plentiful in scattered stations along the east base and foothills of the Sierra Nevada in southeastern Lassen, eastern Plumas, and eastern Sierra Counties, California, south, becoming rarer, through extreme southern Washoe and Ormsby Counties, Nevada, reentering California in Alpine and Mono Counties.—Map No. 28.—May to July.

ASTRAGALUS GIBBSII (the collector, a correspondent of Kellogg) Kell. in Proc. Calif. Acad. Sci. 2: 161, fig. 80. 1862.—"... from the Sierra Nevada, near the head waters of Carson river ... *G. W. Gibbs.*"—Holotypus, CAS!—*Tragacantha Gibbsii* (Kell.) O. Kze., Rev. Gen. 945. 1891. *Homalobus Gibbsii* (Kell.) Rydb. in Bull. Torr. Club 51: 15. 1924.

Homalobus Plummerae (Sarah Plummer, wife of John Gill Lemmon) Rydb. in Bull. Torr. Club 51: 16. 1924.—"Type collected in Sierra County, in 1875, *J. G. Lemmon 622* ..." —Holotypus, NY! isotypus, GH!

The Gibbs milk-vetch is closely related to *A. curvicarpus,* and the two species have been treated by Jones (1923, p. 140) and subsequently by Jepson (1936, p. 366) as no more than varietally distinct. However even where their ranges come into close contact in northeastern California, *A. Gibbsii* differs from *A. curvicarpus* in the longer, looser vesture, longer calyx-teeth, proportionately shorter banner, and broader pod of thicker texture which is transversely dilated at maturity to a degree never approached by allied species. The connate stipules provide a qualitative criterion separating *A. Gibbsii* from all other *Collini.* In the form of the stipules, as well as in some aspects of the legume, *A. Gibbsii* is reminiscent of *A. bicristatus* (of the transverse ranges of southern California), but its nodding flowers and basally saccate calyx are characteristic of the present section. Whether the connate stipules of *A. Gibbsii* have been acquired by an independent mutation, or present a primitive character lost by its near kindred, or alternatively have been derived by introgression from another source, is of great theoretical interest but remains an open question. It is probably no more than a coincidence that the rare *A. (Bicristati) Webberi* is endemic to a small area in the Sierra Nevada immediately to the west of *A. Gibbsii;* but this species could have supplied the factor for connate stipules.

Flowering specimens of *A. Gibbsii* and *A. collinus* are easily confused, for they are similar in general appearance and in details of the pouched calyx and modified banner. Material of the Gibbs milk-vetch collected by Anderson and Lemmon was misidentified by Gray, in *Botany of California,* as *A. cyrtoides,* a synonym of *A. collinus*; and reports of *A. Gibbsii* from westcentral Idaho and from the Blue Mountains in Oregon have persisted in the literature until recent years. The ordinarily straight, always narrower, and more strongly flattened pod readily distinguishes *A. collinus,* not to mention the impressed reticulation of the pod-valves, the free stipules, and other small differences.

In Lassen County the petals of *A. Gibbsii* are distinctly yellow when fresh; this seems to be true of the species as a whole. As in some forms of *A. curvicarpus,* particularly its var. *subglaber,* the banner is fleshy-thickened in the fold of the blade and turns brown or brown-spotted unless dried with great dispatch. The flowers are heavily but disagreably fragrant.

The precise southern limit of the species has not been determined. There is only one record from Mono County (*R. King in 1911,* ND) and this lacks exact locality-data; it has been mapped arbitrarily in the northern part of the county. The Gibbs milk-vetch may occur in the upper Walker Valley and is to be sought in that neighborhood.

XVII. Sectio TWEEDYANI

Tall, caulescent perennials, with shallowly buried root-crown or caudex; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with ± 11–23 leaflets; *flowers* racemose, ascending, of moderate size, the banner ± 15–18.5 mm. long; *calyx-tube* broadly cylindric or deeply campanulate, gibbous-convex behind the pedicel; *petals* ochroleucous, regularly graduated, the banner sigmoidally arcuate, the keel-tip obtuse; *pod* erect or incurved-ascending, persistent together with the thickened pedicel until after dehiscence, stipitate, the oblong-ellipsoid body somewhat laterally compressed, bicarinate by the salient sutures, the fleshy valves becoming leathery, not inflexed; *ovules* 12–19.—Sp. 1, xerophyte, of the lower Columbia Valley, northern transmontane Oregon and adjacent Washington.

ASTRAGALUS sect. TWEEDYANI, sect. nov., *Collinis* sine dubio proximi, sed floribus ac leguminibus erecto-adscendentibus (nec declinato-pendulis), his diu persistentibus apice tantum (nec apice simul ac per stipitem) in situ (nec post lapsum) dehiscentibus graviuscule discrepantes.—Sp. unica: *A. Tweedyi* Canby.

The Tweedy milk-vetch has traditionally and no doubt correctly been associated with *A. collinus,* type-species of the preceding section, of which it has the peculiarly modified flower with basally gibbous-saccate calyx and sigmoidally arched banner. In sect. *Collini* the oblique attachment of the pedicel to the calyx has apparently developed together with a nodding flower, but in *A. Tweedyi* the same type of calyx is held erect. Furthermore the fruits, also erect or incurved-ascending, persist with the thickened pedicels and dehisce in situ, through the beak alone and apparently never through the stipe as in sect. *Collini.* This orientation of a calyx which seems designed for a nodding position must almost certainly be an acquired character, but there is no evidence as to whether the modification came about through independent mutation or through introgression from another source. The technical attributes of *A. Tweedyi* are in several ways intermediate between the *Collini* and some sympatric *Reventi-arrecti* or *Conjuncti.*

79. Astragalus Tweedyi

Robust perennial, loosely strigulose or villosulous with fine, incurved or sinuous hairs up to 0.35–0.55 mm. long, the herbage greenish or in youth cinereous, the leaflets pubescent on both sides, but often more thinly so and deeper green above; *stems* few, stout or occasionally slender and wiry, stiffly erect or ascending, (2.5) 3.5–8 dm. long, subterranean for a space of 1.5–5 cm., naked and usually simple through the lowest emersed internodes, thereafter leafy, paniculately branched and bearing several spurs in the median axils, the whole composed of ± 10–17 internodes; *stipules* (1) 2–7 mm. long, the lowest shortly adnate to the suppressed petiole, ovate or broader than long, early becoming papery and irregularly deciduous, decurrent around ⅓ to nearly the whole stem's circumference, the median and upper ones herbaceous, deltoid, triangular, or drawn out into a lanceolate, often deflexed blade; *leaves* 3–10 (13) cm. long, subsessile or the lowest ones shortly petioled, with (7) 11–23 narrowly oblong-oblanceolate to linear-oblong, retuse, truncate, rarely obtuse, flat or loosely folded leaflets 5–18 (25) mm. long; *peduncles* erect, (5) 7–15 cm. long, usually well surpassing the leaf; *racemes* 12–35 (40)-flowered, rather compact at early anthesis, the axis elongating, 2.5–10 cm. long in fruit; *bracts* narrowly ovate to lanceolate, 1.5–6 mm. long; *pedicels* ascending, straight, at anthesis 0.8–2 mm., in fruit somewhat thickened, 1–3 mm. long; *bracteoles* 0; *calyx* 8–10.5 mm. long, villosulous with white and sometimes a few black hairs, the strongly oblique disc 0.8–1.6 mm. deep, the tube 7.5–9 mm. long, (3.3) 3.8–5 mm. in diameter, gibbous-convex behind the pedicel, the broadly subulate teeth 1–2.1 mm. long, the ventral pair commonly deltoid and shorter than the rest, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, immaculate; *banner* broadly oblanceolate, 15–18.6 mm. long, the blade recurved through ± 45°, sometimes further in age, (5) 6.8–9 mm. wide; *wings* (14.2) 15–18 mm. long, the claws 7.5–9.6 mm., the oblong-elliptic or -oblanceolate, obtuse, nearly straight blades (7.4) 8–9.5 mm. long, (2.3) 2.8–3.6 mm. wide; *keel* 11.5–14.3 mm. long, the claws 7.2–8.9 mm., the half-obovate blades 4.5–6 mm. long, 2.7–3.4 mm. wide, abruptly incurved through 85–95° to the bluntly deltoid apex; *anthers* 0.5–0.7 mm long; *pod* stipitate, the stiff but slender, ascending stipe 6–10 mm. long, incurved distally to bring the body to perpendicular at a distance from the raceme-axis, the body oblong-ellipsoid, cuneate or shortly acuminate at base, abruptly cuspidate-beaked, (1) 1.2–1.5 cm. long, (3) 3.4–4 (5.4) mm. in diameter, a little compressed laterally, with strongly convex faces, bicarinate by the elevated sutures, the green, glabrous, lustrously fleshy valves becoming stramineous, stiffly leathery, transversely rugulose-reticulate and often wrinkled lengthwise, not inflexed; *dehiscence* apical, the beak gaping to release the seeds; *seeds* (little known) brown, apparently smooth, and ± 2–2.5 mm. long.—Collections: 22 (ii); representative: *Hitchcock & Martin 4801* (WS, WTU); *Peck 26,290* (CAS, RSA, WILLU); *J. W. Thompson 4767* (WTU); *Ripley & Barneby 10,806* (CAS, RSA).

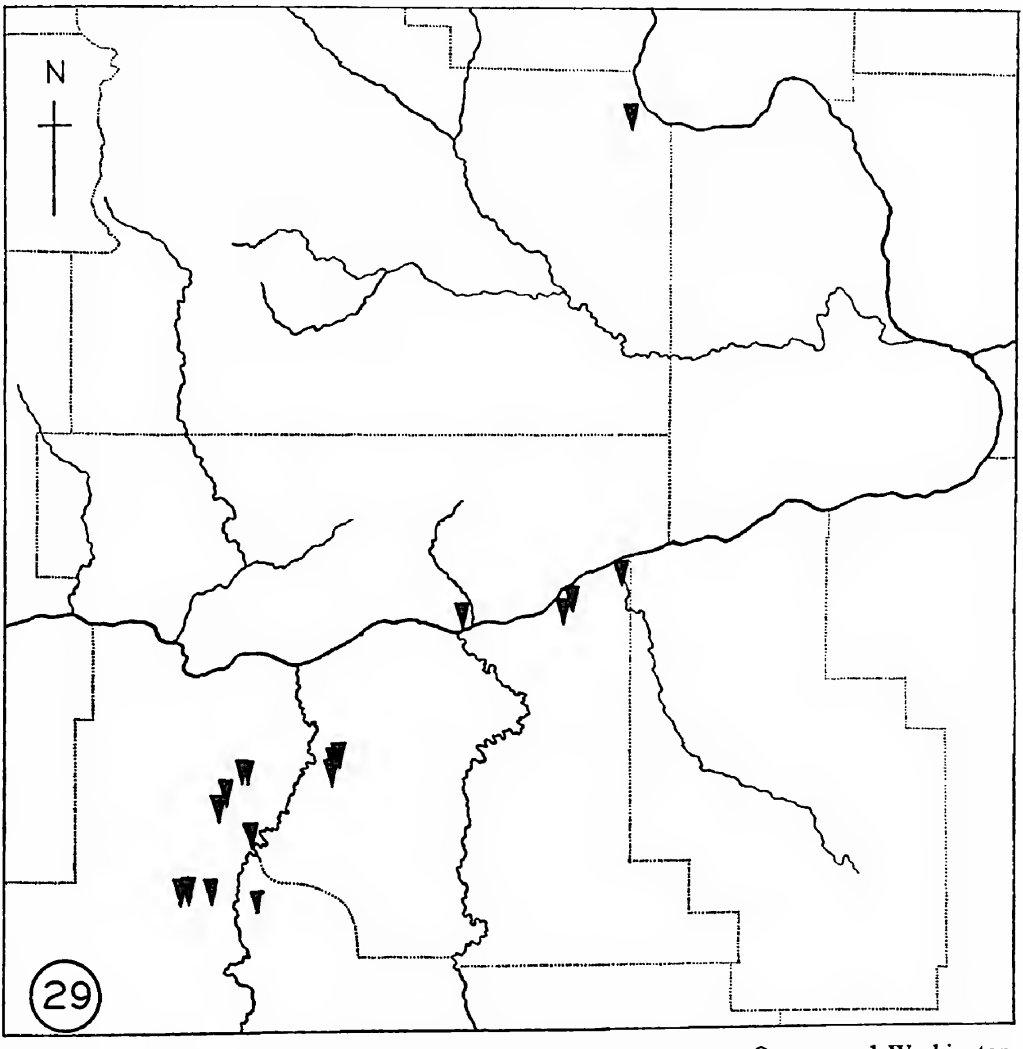
Dry hillsides, grassy banks, and stony meadows or hilltops, in light dry basaltic soils, sometimes among sagebrush, 250–2350 ("3000") feet, locally plentiful in the lower Deschutes and Columbia Valleys in Wasco, Sherman, and Gilliam Counties, Oregon, and adjacent Klickitat County, Washington; one old record from Columbia River in Yakima County, Washington. — Map. No. 29. — Late May to July, the fruit long persisting.

Astragalus Tweedyi (Frank Tweedy, 1854–1937) Canby in Bot. Gaz. 15: 150. 1890. —"Collected by Mr. Howell 'in prairies, Eastern Oregon,' and distributed by him as *A. collinus* Dougl.; and by Mr. Tweedy (no. 613) and Mr. Brandegee (no. 731) on 'hills along the Columbia River, Yakima County, Washington territory'."—Lectotypus, labeled "Hills along

the Columbia River, Washington Territory, October, 1883, *Brandegee 731 & Tweedy 613*," NY (herb. Canby.)! isotypi, GH, US! paratypi *(Howell in 1881)*, G, K, NY, WS, ORE (dated "1880")!—*Phaca Tweedyi* (Canby) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 371. 1906. *Homalobus Tweedyi* (Canby) Rydb. in Bull. Torr. Club 51: 14. 1924.

The Tweedy milk-vetch is a tall, graceful astragalus, with comparatively few, erect, and often paniculately branching stems and handsome, rather dense racemes of ascending creamy-white flowers. It is technically remarkable for its tumid, pallid, basally pouched calyx and incurved-ascending, stipitate, unilocular pod which remains securely attached to the raceme-axis until after dehiscence, indeed long after the seeds themselves are shed. The fruits are similar in structure to those of *A. collinus,* but less strongly compressed, of somewhat thicker texture, and they tend, like those of several *Reventi-arrecti,* to become wrinkled lengthwise as well as reticulate when fully ripe or dried.

All modern records of *A. Tweedyi* are concentrated into a small area along the Columbia and lower Deschutes Rivers, extending along the Columbia from the mouth of Willow Creek to that of the John Day, thence south to Tygh Valley and Maupin, where the species is locally abundant. The type-locality, supposedly on the Columbia in Yakima County, has not been confirmed but has been mapped arbitrarily in the northeast corner of the county.



Map No. 29. The Great Bend of the Columbia River, transmontane Oregon and Washington. Range of *A. Tweedyi.*

XVIII. Sectio PODOSCLEROCARPI

Caulescent perennials, with superficial or shallowly subterranean root-crown or shortly forking caudex; *vesture* basifixed; *leaves* imparipinnate, with 7–17 leaflets; *flowers* racemose, loosely ascending, of moderate size, the banner ± 13–20 mm. long; *pedicels* thickened in fruit, tardily disjointing with the calyx and pod; *calyx-tube* deeply campanulate or cylindric, oblique but not gibbous at base; *petals* whitish or lilac-tinged, regularly graduated, the banner recurved through 40–45°, the keel-tip obtuse; *pod* pendulous or horizontally spreading, stipitate, the laterally compressed body lunately to falcately incurved or coiled, bicarinate by the sutures, the fleshy valves becoming leathery, not inflexed; *dehiscence* apical and basal (through the stipe), after falling; *ovules* (14) 20–36.—Spp. 3, xerophytes, of the Columbia Basin, interior Washington, extreme northeastern Oregon, and southern British Columbia.

ASTRAGALUS sect. PODOSCLEROCARPI Gray in Proc. Amer. Acad. **6**: 225. 1864.—Sp. typica: *A. sclerocarpus* Gray.—*Astragalus* sect. *Podosclerocarpus* Sheld. in Minn. Bot. Stud. **1**: 125. 1894, an alteration of the epithet to substantival form.

The epithet *Podosclerocarpi* was formed by fusion of the name *sclerocarpus* with its basionym *Phaca podocarpa,* evidently the typus of the section, which otherwise embraced in the first instance only *A. speirocarpus,* a species essentially similar except that the pod is more strongly compressed and coiled into a ring. To this nucleus must now be added *A. sinuatus,* thereby forming a compactly homogeneous group akin to the *Collini* but differing in the ascending flowers and a calyx neither tumid nor basally pouched. The section was unreasonably extended by Jones (1923, p. 142, sequ.) to include the seleniferous *Pectinati* easily distinguished by their connate lower stipules and decurrent leaflets, the *Pterocarpi,* characterized by sessile, readily deciduous, dorsiventrally compressed pods, and some others at least equally dissimilar. The *Podosclerocarpi* were submerged by Rydberg (1924, p. 13, sequ.; 1929, p. 275, sequ.) in *Homalobus* sect. *Collini,* an arrangement initiated by Watson in his Synopsis of the genus (1871, p. 444).

With sect. *Podosclerocarpi* we begin to take up a new series of seven emmenoloboid groups characterized by mostly pendulous, stipitate, unilocular pods and free stipules. The fruit in the first five is laterally compressed and thus similar in form to that of some members of the connate-stipuled *Cusickiani,* to which (as mentioned under the appropriate species) there are several independent indications of a close affinity.

Key to the Species of Sect. Podosclerocarpi

1. Pubescence of the calyx and leaflets mostly straight and appressed; *leaflets* linear or linear-oblong; *body* of the pod obliquely or falcately ellipsoid, 6–9 mm. in diameter, nearly straight to incurved through half a circle; *ovules* 30–36; range of the section ..... 80. *A. sclerocarpus*

1. Pubescence of the calyx and leaflets incumbent or curly; *leaflets* oblong, obovate-cuneate, or cuneate-obcordate; *body* of the pod linear-oblong or oblong in profile, 3.2–7 mm. in diameter, either hamately incurved or coiled into a ring; *ovules* 20–30; relatively local species of w. transmontane Washington (2)
   2. Peduncles mostly 2–5 cm. long; *pedicels* in fruit 1–2.5 mm. long; *body* of the pod tightly coiled (or equivalently contorted) through 1¼–2½ circles; Kittitas, Yakima, Benton and Klickitat Counties ..... 82. *A. speirocarpus*
   2. Peduncles mostly 4.5–12 cm. long; *pedicels* in fruit 2.7–3.5 mm. long; *body* of the pod gently lunate- or hamate-incurved; s. Chelan County ..... 81. *A. sinuatus*

80. ASTRAGALUS SCLEROCARPUS

Diffuse, wiry, sparsely leafy or somewhat junceous, with a long, woody taproot and shortly forking, sometimes shallowly buried caudex, strigulose nearly throughout with straight, appressed, somewhat flattened hairs up to 0.35–0.5 mm. long, the herbage canescent or in age greenish, the leaflets brighter green and more thinly pubescent, medially glabrescent, or sometimes glabrous above; *stems* decumbent and distally ascending, or straggling, 2–5 dm. long, leafless at base, usually branched or spurred at 1–3 of the lowest leaf-bearing nodes, thereafter simple,

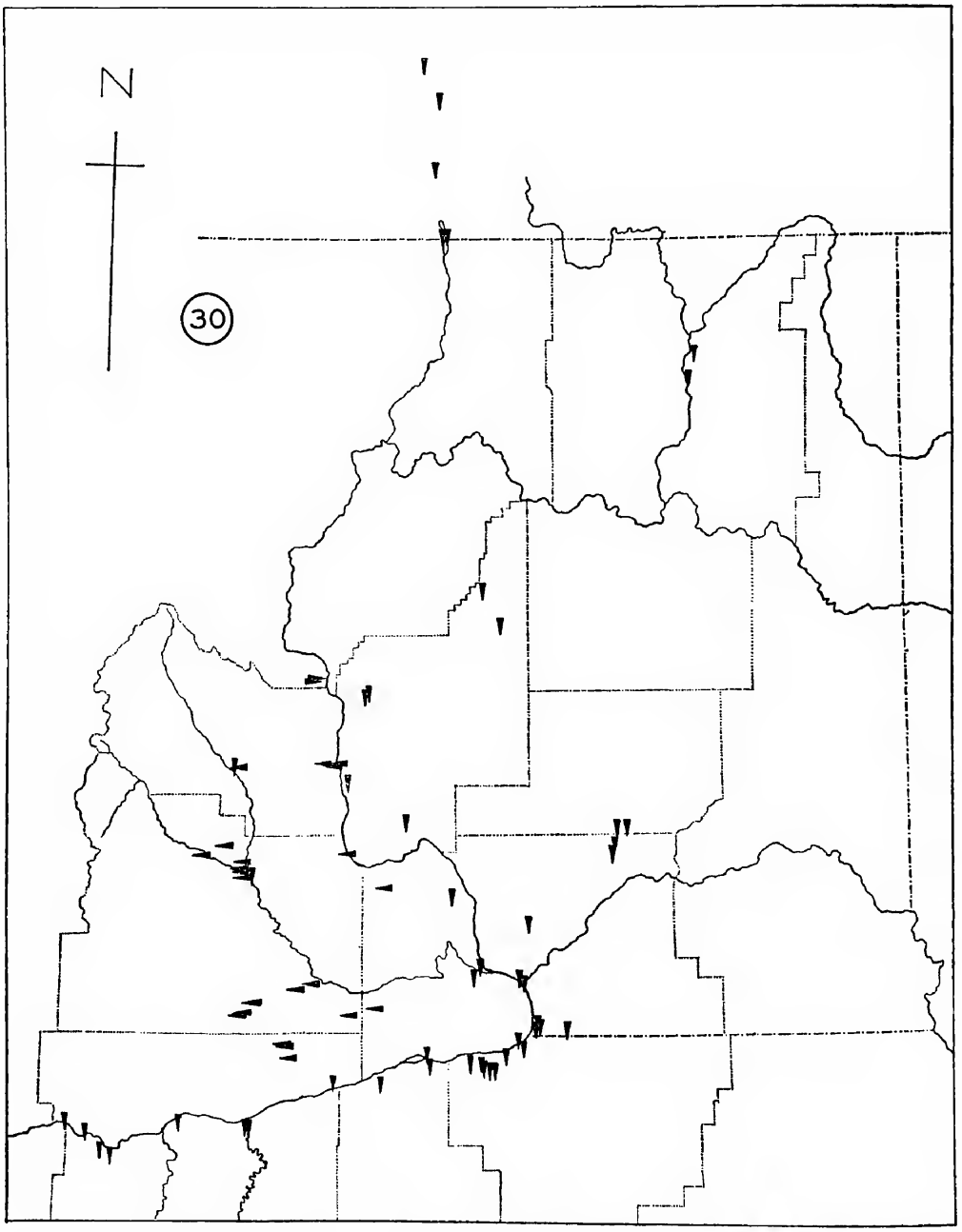
flexuous or zigzag, the main axis composed of ± 10–16 developed internodes; *stipules* 1.5–5 mm. long, the lowest ovate or broader than long, early becoming papery and irregularly deciduous, amplexicaul-decurrent around ½–⅘ the stem's circumference, the median and upper ones narrower, subherbaceous, with triangular or deltoid, erect or deflexed blades; *leaves* (3) 5–13 cm. long, shortly petioled or the uppermost subsessile, with (5) 7–17 distant, linear, linear-oblanceolate, or rarely narrowly oblong, in the uppermost leaves often filiform, obtuse or retuse, flat or involute leaflets 3–23 mm. long; *peduncles* 4–9.5 cm. long, nearly always surpassed by the leaf; *racemes* loosely (3) 7–21-flowered, the axis elongating, (1) 2.5–6.5 cm. long in fruit; *bracts* membranous, ovate, acute or acuminate, 1–2 mm. long; *pedicels* at anthesis ascending, straight, slender, 1–2.5 mm. long, in fruit thickened, arcuately spreading, 1.7–2.5 mm. long; *bracteoles* nearly always 2; *calyx* 5.9–8 mm. long, finely strigulose with black or largely black hairs, the slightly oblique disc 1–1.4 mm. deep, the membranous, deeply campanulate or subcylindric tube 5.3–7 mm. long, 2.6–3.6 mm. in diameter, the broadly subulate teeth 0.5–1.3 mm. long, the ventral pair commonly shortest and broadest, the orifice oblique, the whole becoming scarious, marcescent unruptured; *petals* whitish, the tips of the banner and wings tinged with pale lilac, the keel maculate with dull purple; *banner* rhombic-obovate, 13–16.3 mm. long, (6.8) 7.5–10 mm. wide; *wings* 12.8–14.5 mm. long, the claws 5.4–7.8 mm., the oblong or oblong-oblanceolate, obtuse or erose-emarginate, straight or nearly straight blades 7.2–8.2 mm. long, 2.1–2.8 mm. wide; *keel* 10–12.1 mm. long, the claws 5.3–7.6 mm., the lunately half-elliptic blades 4.6–5.4 mm. long, 2.6–3 mm. wide, incurved through 85–100° to the rounded apex; *anthers* 0.6–0.8 mm long; *pod* pendulous, stipitate, the stipe 1.2–2 cm. long, arched downward out of the calyx, sigmoidally incurved distally, very gradually expanded into the body, the latter lunately or falcately ellipsoid, 2–3.5 cm. long, (5.5) 6.5–9 mm. in diameter, long-acuminate at both ends or at base only, then contracted at apex into a stoutly cuspidate beak, subterete when first formed, becoming laterally compressed when ripe or dried, prominently carinate by the thick, salient, cordlike ventral suture and the sometimes undulate dorsal suture, the lateral faces convex, the thick, fleshy, green valves becoming stiffly leathery or subligneous, brownish-stramineous, coarsely rugulose-reticulate, densely or at length thinly strigulose, not inflexed; *ovules* 30–36; *seeds* brown, smooth but dull, 1.9–3 mm. long.—Collections: 47 (iii); representative: *Rollins, Pickett & Dillon 864* (CAS, WIS, WS, WTU); *C. W. Sharsmith 4035* (CAS, WS, WTU); *H. T. Rogers 527* (CAS, WIS, WS); *Cronquist 6241* (ID, NY, RSA, SMU, WS), *6485* (ID, NY, SMU, TEX, WS); *Suksdorf 852* (ND, WS).

Dunes and sandy barrens, 200–1600 feet, locally plentiful along the banks of the Columbia and more sparingly along the lower Snake and Yakima Rivers from The Dalles upstream to Kettle Falls, in northern transmontane Oregon and eastern Washington, and along the upper Okanogan River in southern British Columbia.—Map No. 30—April to July.

ASTRAGALUS SCLEROCARPUS (with hard, rigid pods) Gray in Proc. Amer. Acad. 6: 225. 1864, based on *Phaca podocarpa* (with stalked pods) Hook., Fl. Bor.-Amer. 1: 142. 1831 (non *A. podocarpus* C. A. Mey., 1831).—"Dry sandy and barren grounds, at the Great Falls of the Columbia, rare . . . in Mr. Douglas' collection."—Holotypus collected in 1825, K! isotypi, GH, OXF!—*Tragacantha sclerocarpa* (Gray) O. Kze., Rev. Gen. 948. 1891. *Homalobus podocarpus* (Hook.) Rydb. in Bull. Torr. Club 51: 19. 1924.

The Dalles milk-vetch, *A. sclerocarpus,* is an untidily straggling, sparsely leafy herb of pronounced xerophytic habit, remarkable for the large, fleshy, ultimately two-keeled pods exserted from the calyx on long, sigmoidally arched stipes. It is one of the several interesting endemic species encountered along the banks of the Columbia, where it is often associated

with *A. succumbens*. The plants flower in early spring, but are active vegetatively for four or five months, and the pods ripen slowly, seldom reaching the stage of dehiscence before midsummer. When in young flower *A. sclerocarpus* closely resembles and has been mistaken for its near relative *A. speirocarpus*, for the leaflets of some early leaves are sometimes comparatively broad and the flowers are almost identical in shape and coloring. The vesture of appressed, somewhat flattened hairs is ordinarily a good differential character in doubtful cases. The leaflets of the upper leaves, developed as the fruits mature, are always much narrower in *A. sclerocarpus* than in its kindred, often filiform or nearly so, and commonly also reduced in length. The pod varies greatly in outline as viewed in profile, and in curvature from a shallow



Map No. 30. Eastern Washington and parts of adjoining states. Range of ▼ *A. sclerocarpus;* of ⧫ *A. sinuatus*; and of ⧫ *A. speirocarpus.*

crescent to an open hook. The body tapers so gently into the stipe that it is difficult to differentiate between the two; distally it varies from long-acuminate to abruptly contracted, terminating in either case in a stout, rigid cusp.

Jones has reported the Dalles milk-vetch from the Malheur River in Oregon, but no confirming specimens have been seen. Possibly he mistook an old flowering collection of *A. toanus* for *A. sclerocarpus,* but this is a speculation. A specimen purportedly from "Elko County, Nevada" (*C. L. Hitchcock 19,012,* WS) is almost certainly mislabeled by accident.

81. Astragalus sinuatus

Robust and leafy, with a woody taproot and knotty or shortly forking, multicipital root-crown, villosulous throughout with rather stiff, spreading-incumbent or curly hairs up to 0.4–0.6 mm. long, the herbage densely cinereous, the leaflets somewhat bicolored, equally pubescent on both sides but the upper one brighter green beneath the vesture; *stems* numerous, decumbent with ascending tips, simple or sometimes branched below, 2–4.5 dm. long; *stipules* 2–4.5 mm. long, the lowest ones papery, approximate, semiamplexicaul-decurrent, the upper ones herbaceous, ovate-acuminate or deltoid, the blades often reflexed; *leaves* 2–7 cm. long, widely spreading, all but the lowest sessile or nearly so, with (9) 11–17 (19) obovate-cuneate or oblong-oblanceolate, mostly truncate-retuse or a few very obtuse, flat or loosely folded leaflets (4) 6–16 mm. long; *peduncles* erect or incurved-ascending, 4.5–12 cm. long, equaling or longer than the leaf; *racemes* 8–16-flowered, rather dense at early anthesis, loose in age, the flowers ascending, the axis 1.5–4.5 cm. long in fruit; *bracts* submembranous, triangular-ovate or lanceolate, 2–3 mm. long; *pedicels* at anthesis ascending, straight, slender, 1.5–2 mm. long, in fruit a little thickened, gently arched outward, 2.7–3.5 mm. long; *bracteoles* almost always 2; *calyx* 9–11.5 mm. long, rather densely villosulous with black or mixed black and white hairs, the obliquely campanulate or broadly obconic disc 1.4–2 mm. deep, the membranous, pallid, campanulate to subcylindric, somewhat tumid tube 6.9–8.5 mm. long, 3.7–4.7 mm. in diameter, the triangular-subulate teeth 1.4–3 mm. long, the ventral pair broadest but either longer or shorter than the rest, the whole becoming papery, marcescent unruptured; *petals* whitish, concolorous, or the keel-tip faintly maculate; *banner* broadly rhombic- or oblanceolate-spatulate, deeply notched, 16.6–20 mm. long, 7.7–10.5 mm. wide; *wings* 14.5–17.3 mm. long, the claws 7.3–8.9 mm., the oblong or lance-oblong, obtuse blades 7.9–9.5 mm. long, 2.5–3.1 mm. wide, straight or a trifle incurved distally; *keel* 12–13.4 mm. long, the claws 7.1–8.4 mm., the lunately triangular blades (5) 5.5–6.7 mm. long 3.1–3.5 mm. wide, incurved through 85–90° to the bluntly deltoid apex; *anthers* 0.6–0.85 mm. long; *pod* spreading horizontally or pendulous, stipitate, the straight stipe 5–8 mm. long, the falcately oblong body (1.8) 2–3 cm. long, (4) 5–7 mm. in diameter, cuneate at base, cuneately tapering at apex into a subulate cusp ± 2.5 mm. long, laterally compressed, carinate by both sutures, the ventral one cordlike, the dorsal one equally salient but narrower, sinuate in age, the green, fleshy, densely villosulous valves becoming stramineous, stiffly leathery or subligneous, transversely rugulose-reticulate, not inflexed; *ovules* 24–30; *seeds* brown, smooth but dull, ± 3.5 mm. long.—Collections: 4 (o); representative: *G. H. Ward 261* (CAS, SMU, WS).

Dry hillsides, probably among sagebrush, ± 2000 (?) feet, known certainly only from Colockum Creek, a small tributary of the Columbia River in Chelan County, Washington.—Map No. 30.—Mid-April to June.

Astragalus sinuatus (sinuously wavy, of the pod's dorsal suture) Piper in Bull. Torr. Club 28: 40. 1901.—"Eastern Washington, without definite locality, Brandegee, no. 739, in 1883."—Holotypus, *Brandegee 729* (!), GH!—*Phaca sinuata* (Piper) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 370. 1906. *Homalobus sinuatus* (Piper) Rydb. in Bull. Torr. Club 51: 16. 1924.

Astragalus Whitedii (Kirk Whited) Piper in Bull. Torr. Club 29: 224. 1902.—"Colockum Creek, twenty miles southwest of Wenatchee, Wash., May 17, 1901, *K. Whited, 1353;* also young flowering specimens from the same stations, collected in 1899."—Cotypi, *Whited 1353 & 1042,* the latter collected April 23, 1899, WS! isotypi *(No. 1042),* US (2 sheets) and *(No. 1353),* GH, ORE, RSA, US!—*Homalobus Whitedii* (Piper) Rydb. in Bull. Torr. Club 51: 16. 1924.

The Whited milk-vetch is one of several species first discovered by Brandegee and Tweedy on the Northwestern Expedition organized by William Canby. The material of this collection, very valuable and novel at the time, was distributed without exact locality data, and nothing seems to be known of the route followed by the expedition's members. Only one specimen of *A. sinuatus* seems to have been collected, for the type number is not represented in the Canby herbarium (NY). It is fair to assume that it came from the Columbia Valley in Chelan County or the immediate neighborhood, as the species has been collected subsequently only along Colockum Creek. The type-collection of *A. Whitedii,* unlike that of *A. sinuatus* which is in advanced fruit, bears flowers and pods not fully ripened; but there can be no doubt that, as Piper himself early realized (1906, 1. c.), it represents the same species as Brandegee's plant, for the specimens are closely similar in foliage, vesture, and what can be compared of the calyces at such different stages of growth. Nevertheless the two collections have long been treated as representing different species. Jones (1923, Index) listed *A. sinuatus* in the synonymy of *A. Gibbsii,* a species not known to occur within several hundred miles of eastern Washington, and *A. Whitedii* in that of *A. speirocarpus,* the ripe fruit of which is altogether different. In a sense, Jones's treatment contrives a composite portrait of *A. sinuatus,* for it might be described as resembling *A. speirocarpus* up to the flower, then putting forth a fruit almost like that of *A. Gibbsii.* Rydberg (1924, p. 16) maintained *A. sinuatus* as a distinct species of *Homalobus,* known to him from the typus only, but misinterpreted *A. Whitedii* as the earliest valid synonym of what is now known as *A. (Collini) curvicarpus.* These two species are similar in habit, vesture, and fruit, but differ in the form and orientation of the flower. Moreover, the range of typical *A. curvicarpus* lies well south of Washington.

82. Astragalus speirocarpus

Rather slender, with a woody taproot and shortly forking or knotty caudex, densely strigulose with subappressed and arcuate-incumbent hairs up to 0.3–0.5 mm. long, the herbage cinereous or rarely greenish, the leaflets often brighter green and more thinly pubescent above than beneath; *stems* several or numerous, weakly ascending or diffuse, 1–3.5 dm. long, simple and leafless at base, usually branched or spurred at 1–3 nodes preceding the first peduncle, the main axis composed of ± 6–11 internodes; *stipules* (1) 1.5–4 (5) mm. long, the lowest mostly ovate, obtuse, early becoming papery and brownish, amplexicaul-decurrent around ½–⅘ the stem's circumference, the median and upper ones shorter, narrower, with deltoid or triangular, erect or deflexed blades; *leaves* 1.5–7.5 cm. long, all subsessile or the lowest shortly petioled, with 7–17 (21) cuneate-oblanceolate, oblong, cuneate-obcordate, or inversely deltoid, truncate to deeply retuse, mostly flat leaflets 2–10 (12) mm. long; *peduncles* erect or incurved-ascending, (1) 2–5 (6.5) cm. long, usually much shorter than the leaf; *racemes* loosely, at first anthesis rather closely, (3) 7–17 (20)-flowered, the axis a little elongating, 1–3.5 (5) cm. long in fruit; *bracts* membranous, ovate or lanceolate, 1–2.5 mm. long; *pedicels* at anthesis slender, ascending, 1–1.5 mm. long, in fruit thickened, arcuately spreading or declined, 1–2 (2.5) mm. long; *bracteoles* commonly 2; *calyx* 5.2–8 (9.1) mm. long, villosulous with spreading and incumbent, black or mixed black and white hairs, the somewhat oblique disc 0.9–1.4 mm. deep, the deeply campanulate or subcylindric tube 4.7–7.3 mm. long, 2.6–3.8 mm. in diameter, the broadly subulate or triangular, obtuse teeth 0.5–1.2 mm. long, the ventral pair commonly shortest and broadest, the whole becoming papery, marcescent unruptured; *petals* whitish or lilac-tinged, the keel tipped with dull purple; *banner* rhombic-obovate or -oblanceolate, 14.7–20 mm. long, 5.8–9 mm. wide; *wings* 12.1–17.2 (18) mm. long, the claws 6.2–8.1 (9.1) mm., the narrowly oblong, obtuse or subemarginate, nearly straight blades 7–10.2 mm. long, 1.6–2.7 mm.

wide; *keel* 10.6–13 (14.5) mm. long, the claws 6.3–8 (9) mm., the broadly half-elliptic blades 4.8–6 (6.4) mm. long, 2.3–3.2 mm. wide, incurved through 85–95° to the rounded apex; *anthers* 0.5–0.75 mm. long; *pod* pendulous, declined, or (from humistrate peduncles) horizontally spreading, stipitate, the stipe (4) 5–11 mm. long, proximally straight or slightly arched downward, then incurved and gradually expanded into the body, the body linear-oblong, (2-7) 3.2–5 (6) mm. wide, coiled into a flat spiral through 1¼–2½ circles, or by twisting through different planes elaborately and irregularly contorted, acuminate at apex, strongly compressed, bicarinate by the salient sutures, the ventral one often produced as a narrow, low-dentate wing, the faces nearly flat to low-convex, the somewhat fleshy, green or faintly mottled, strigulose valves becoming stiffly leathery and stramineous or brownish, the coarsely reticulate exocarp ultimately splitting along the sutures and exfoliating irregularly from the nearly smooth endocarp, the tardily splitting ventral suture tending to become detached and separating into two tough fibres; *ovules* (14) 20–28 (30); *seeds* (little known) soot-black, sparsely pitted, dull, (?1.8) 2.7–3.1 mm. long.—Collections: 29 (ii); representative: *Griffiths & Cotton 45* (POM, WS); *Piper 2758* (NY, WS); *Hitchcock & Marsh 3331* (CAS, WS, WTU); *J. W. Thompson 11,439* (CAS, NY, RSA, WS, WTU), *14,298* (CAS, NY, WTU).

Dry hillsides and valley flats in stony or sandy soils overlying basalt, commonly in sagebrush scabland, 900–2000 (2600) feet, locally plentiful in the valleys of the Yakima and Columbia Rivers in Yakima and Kittitas Counties, Washington, extending south just into eastern Klickitat and western Benton Counties.—Map No. 30.—May to July.

ASTRAGALUS SPEIROCARPUS (with coiled pod) Gray in Proc. Amer. Acad. 6: 225. 1864.—"Wenass, in the valley of the Upper Columbia River, Dr. Lyall, ex herb. Kew."—Holotypus, Lyall's *Phaca No. 1,* collected in 1860, GH! isotypus, K!—*Tragacantha speirocarpa* (Gray) O. Kze., Rev. Gen. 948. 1891. *Phaca speirocarpa* (Gray) Piper in Contrib. U.S. Nat. Herb. 11: (Fl. Wash.): 370. 1906. *Homalobus speirocarpus* (Gray) Rydb. in Bull. Torr. Club 51: 18. 1924.

At anthesis the medick milk-vetch, *A. speirocarpus,* is not an especially distinguished astragalus, although the neat gray foliage and lilac-tinged (when dry, mostly ochroleucous) flowers are quietly attractive. The pod, however, is most remarkable, not only for its exactly spiral or sometimes spirally contorted curvature, but also for its mode of dehiscence, of which the last stage is still unknown. Gray (1864, l.c.) remarked of this and the preceding species, *A. sclerocarpus,* that both sutures of the pod tend to separate in age from the body in the manner of some *Mimosoideae,* but this does not always occur. The ventral suture, which is often narrowly winged, seems normally to split lengthwise into two parts as the pod ripens; and at the same time the exocarp, containing the externally prominent nervature, separates from both sutures and exfoliates from the endocarp in an irregular manner. The true dehiscence proceeds only a short way downward through the narrowly gaping beak and also a short distance upward through the stipe, but it is not known how the seeds near the middle of the spiral escape to the ground. Possibly they are released only through disintegration of the pod by winter weathering.

The close relationship between *A. speirocarpus* and *A. sclerocarpus* is evident especially in flowering plants, which are sometimes difficult to distinguish, and it is that much more remarkable that the range of the medick milk-vetch lies wholly within that of its commoner relative. There is no evidence that they are ever found closely associated; very possibly a more exact knowledge of their ecology will reveal that they are kept apart by some edaphic factor. So far as I can learn, *A. speirocarpus* is nearly always associated with sagebrush in a variety of light sandy or stony soils, whereas *A. sclerocarpus* is found most often on dunelike barrens of semidesert character where competition is less severe.

XIX. Sectio CUSICKIANI

Caulescent perennials, with aerial, superficial, or subterranean root-crown or caudex, in one subsection stoloniferous; *vesture* commonly basifixed (partly

dolabriform in some forms of *A. ceramicus*); *stipules* (at least the lowest) connate; *leaves* imparipinnate, the leaflets up to 21 (23), often fewer, sometimes reduced in size, number, or both, in some upper or all leaves rarely absent, the leaf then reduced to a naked rachis, the terminal leaflet often decurrent; *racemes* loosely few- or many-flowered, the flowers declined in age, small or of medium size, the banner 6.5–17.5 mm. long; *calyx-tube* campanulate; *petals* white, ochroleucous, or purplish, the banner variably recurved, the keel-tip triangular or deltoid, obtuse or subacute; *pod* declined or pendulous, stipitate, exceptionally sessile (*A. ceramicus* var. *apus*), continuous with the receptacle and falling tardily with the disjointing pedicel, the body either narrowly oblong and strongly compressed or bladdery-inflated and obovoid-ellipsoid, the valves papery or papery-membranous, not inflexed; *dehiscence* primarily basal, through the stipe and ventral suture, sometimes also finally apical; *ovules* 10–30 (37). — Spp. 7, xerophytes, of the Columbia and Great Basins and Colorado Plateau, one or more extending north into southern British Columbia, the North Coast Ranges of California and southwestern Oregon, south to the mountains of interior southern California and northern Baja California, east to the upper Rio Grande Valley in northern New Mexico and across the Great Plains from North Dakota to the Oklahoma Panhandle.

The section *Cusickiani* is an eminently natural one, even though it includes some important modifications in the position and elaboration of the caudex, in the hair-attachment, in the inflation of the pod-body, and in reduction of the foliage. Characters common to all its members are connate lower stipules, campanulate-tubed calyx, and pendulous, stipitate pod of papery or papery-membranous texture, dehiscent primarily at base on the ventral side. The three subsections group themselves around subsect. *Cusickiani,* of which *A. Cusickii* itself provides the point of contact for threads of relationship leading outward in several directions. The American *Astragali* with inflated pods have traditionally been grouped together, regardless of other characters, into a heterogeneous, certainly polyphyletic assemblage (*Inflati* auct. or *Phaca* sensu Rydberg); but one need only examine the constituent members of sects. *Hemiphragmium, Scytocarpi,* or *Ervoidei* to appreciate that this particular modification of the fruit has occurred independently in several evolutionary lines. The mature, bladdery fruit of *A. Cusickii* is superficially very different from the narrow, flattened one of *A. filipes,* but it is possible to select flowering specimens of these two species so nearly alike in every fine detail that identification is virtually impossible without clues from the locality; and it is worth noting that the fruit of *A. Cusickii* var. *flexilipes* is sometimes only a little inflated and then distinctly wider between the sutures than between the middle of the valves. There can be no question that *A. Cusickii* and *A. filipes* are much closer relatives than one who is accustomed to finding them referred by Rydberg to different genera would easily suspect. Until the recent discovery of *A. sterilis,* which might be described as a miniature *A. Cusickii* in everything but the rhizomatous caudex, *A. ceramicus* seemed rather isolated in the genus. It may have arisen independently of the *Cusickiani* from another (although surely homaloboid) source, but it cannot be excluded from any section of which *A. sterilis* forms a part. While *A. Cusickii* has been singled out as central to the section, it would be a mistake to regard it as primitive, or in any sense ancestral to the group. On the contrary, subsects. *Cusickiani* and *Picti* represent terminal branchlets on the evolutionary tree, and it is to subsect. *Inversi* that one must turn to find clear indications of relationship to other homaloboid groups, such as the free-stipuled *Collini* and *Lonchocarpi* and the perhaps even more closely allied *Ervoidei* and *Scytocarpi.*

The earliest sectional name typified by a member of the section is *Homalobus* sect. *Stenophylli* Rydb. (1917, p. 509, in clave), based immediately on *H. stenophyllus* sensu Rydb. but resting ultimately on *A. leptophyllus* Nutt. non Desf. (= *A. stenophyllus* T. & G.). The identity of *A. leptophyllus* is controversial, and it is treated below (see *A. filipes*) as a nomen ambiguum. It seems best to reject the sectional epithet as ineligible, on the grounds that it cannot be typified with any certainty. The next prior name in the sectional category must be chosen from several published in Rydberg's monograph (1929) under the genus *Phaca*: *Cusickianae, Hookerianae,* and *Pictae.* The last two are based on later homonyms and are rejected on that score. I have therefore taken up the epithet *Cusickiani,* fortunately allusive to a species morphologically central to the section.

Key to the Subsections of Sect. Cusickiani

1. Pod not inflated, linear-oblong or -lanceolate in profile, laterally compressed, 2-sided, the sutures both salient, the faces flat or low-convex, 3–6 mm. wide ..... XIX (i). Subsect. *Inversi*
1. Pod moderately or greatly inflated, 6–25 mm. in diameter, usually bladdery, commonly terete or obcompressed, if at all laterally compressed then the faces tumid and high-convex (2)
   2. Stems arising together from the root-crown at or shortly below soil-level, or from a forking, superficial caudex ..... XIX (ii). Subsect. *Cusickiani*
   2. Stems arising singly or few together from a deeply buried root-crown or from buds on slender, horizontally creeping rhizomes ..... XIX (iii). Subsect. *Picti*

XIX (i). Subsectio Inversi

Root-crown determinate, ultimately pluricipital, situated at or just below soil-level; *vesture* basifixed; *terminal* leaflet either jointed or decurrent; *pod-body* linear-oblong or lanceolate in outline, compressed, with flattened faces, the sutures filiform but salient.—Spp. 3, of northern California and adjoining Oregon, 1 also widely dispersed thence to southern British Columbia, southern Idaho, Nevada, and interruptedly south to northern Baja California.

Astragalus sect. Cusickiani subsect. Inversi (Jones), comb. nov., based on *Astragalus* sect. *Homalobi* subsect. *Inversi* Jones, Rev. Astrag. 66, in clave. 1923.—Sp. typica: *A. inversus Jones.*

Homalobus sect. *Stenophylli* Rydb., Fl. Rocky Mts. 509, in clave. 1917.—Sp. typica: *H. stenophyllus* (T. & G.) sensu Rydb., nom. ambig.

Key to the Species of Subsect. Inversi

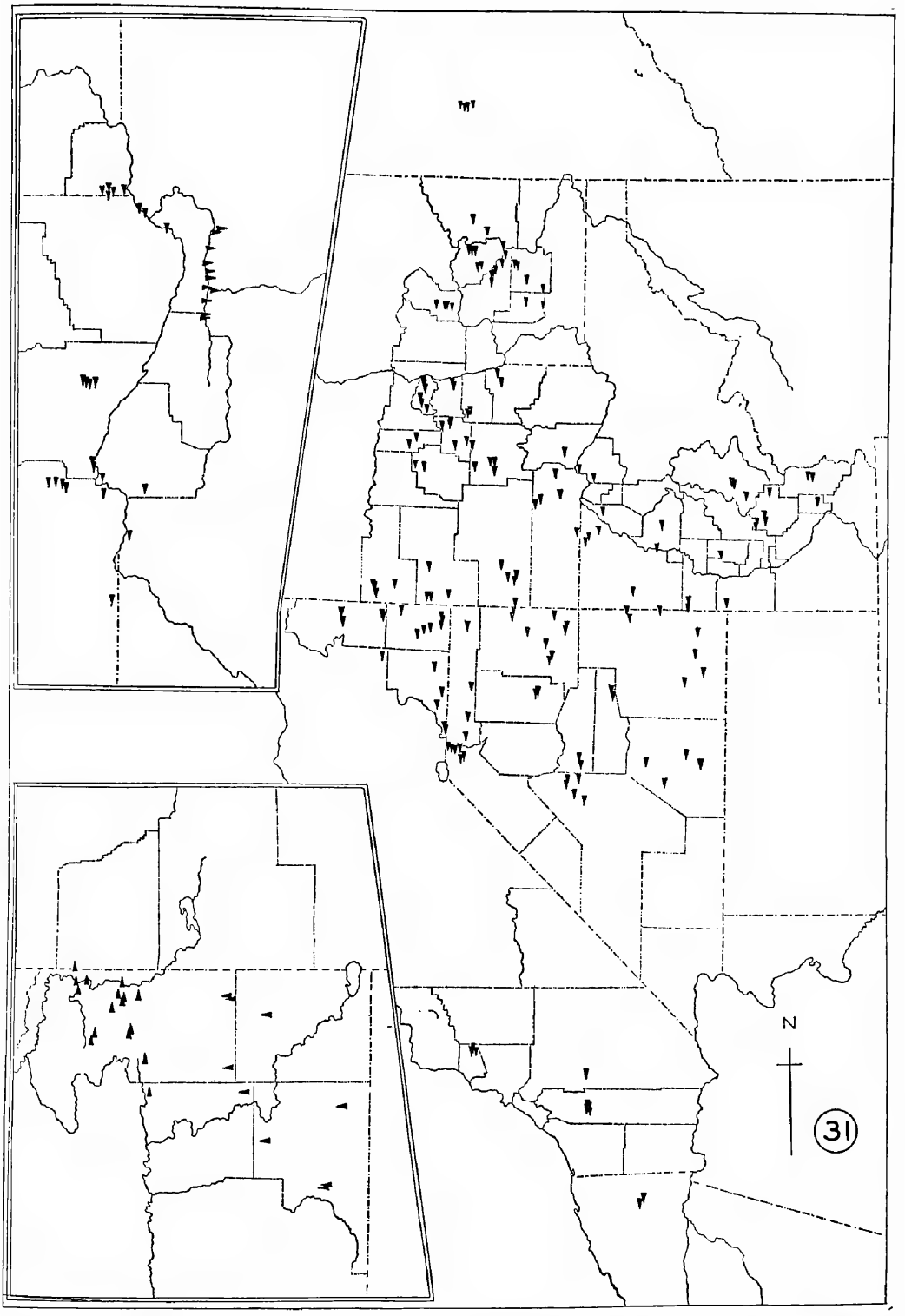
1. Herbage, pedicels, and calyx strigulose with appressed or subappressed hairs, sometimes almost glabrous; *calyx-tube* mostly 3–5.5 mm. long, 2.5–3.5 mm. in diameter; widespread (2)
   2. Leaflets mostly 9–19; *petals* whitish or cream-colored, immaculate, the blades of the keel abruptly incurved through 95–120° and about as long as the claws; *pod-body* never mottled, either glabrous or strigulose, but always glabrous in the range of the next; widespread ..... 83. *A. filipes*
   2. Leaflets mostly 5–11; petals pinkish-red with whitish or buff-colored banner- and wing-tips, the blades of the keel lunately lanceolate, incurved through 40–85°, longer than the claws; *pod-body* strigulose, or if glabrous mottled; Modoc to Siskiyou and Lassen Counties, California ..... 84. *A. inversus*
1. Herbage, pedicels and calyx villous-villosulous with loosely ascending, spreading and incurved, or curly hairs: *calyx-tube* 5.2–7 mm. long, 3.5–4.5 mm. in diameter; upper Sacramento and Klamath Valleys, Shasta County, California to s. Jackson County, Oregon ..... 85. *A. californicus*

83. Astragalus filipes

Robust or quite slender, commonly tall and sparsely leafy, with a thick, woody taproot and shortly forking or knotty caudex at or just below soil-level, varying from nearly glabrous (below the calyx) to densely strigulose with straight and appressed (exceptionally incurved-ascending) hairs up to 0.2–0.6 mm. long, the herbage green or cinereous, the leaflets glabrous on both sides, thinly pubescent on either side and glabrous on the other, or cinereous on both sides and then often more densely pubescent above than beneath; *stems* several or numerous, commonly erect and ascending in clumps, more rarely diffuse or trailing, leafless and purplish at base, striate upward, (2) 2.5–5.5 (9) dm. long, either paniculately branched from near the base upward, or simple below and branched or spurred at 1–5 nodes preceding the first peduncle, occasionally simple; *stipules* dimorphic, those at the lowest, leafless nodes papery-membranous, purplish or brownish, 2–5 mm. long, amplexicaul and connate into a subtruncate or bidentate sheath (sometimes,

especially in vigorous plants, ruptured in age or irregularly circumscissile), the median and upper ones mostly shorter, herbaceous above the pallid base, varying from semi- to fully amplexicaul, but free or united only by a stipular line, with deltoid or deltoid-acuminate, often spreading blades; *leaves* 2.5–10 (12) cm. long, all shortly petioled or the uppermost subsessile, with (5) 9–19 (23) commonly distant and often scattered, linear, filiform, more rarely linear-elliptic or -oblong, obtuse, truncate-retuse, less often subacute, involute or flat leaflets 3–21 (25, exceptionally 30) mm. long; *peduncles* erect or strictly ascending, (4.5) 6–22 cm. long, the inflorescence projected well above the foliage; *racemes* loosely (4) 10–30-flowered, the flowers early spreading and then declined, the axis soon elongating, (3) 5–23 cm. long in fruit, the pods more or less secund; *bracts* membranous, ovate, ovate-acuminate, or lanceolate, 1–2.5 (3.5) mm. long; *pedicels* slender, at anthesis straight, ascending, in fruit either straight and spreading or widely ascending, or arched out- and downward, little thickened, (1.5) 2–5 (6) mm. long; *bracteoles* 0 (rarely a minute scale); *calyx* 4–6.2 (7.7) mm. long, thinly or densely strigulose with black, mixed black and white, rarely all white hairs, the subsymmetric disc 0.8–1.3 (2) mm. deep, the pallid tube 3.3–5.5 (6.4) mm. long, 2.4–3.5 (4.4) mm. in diameter, the deltoid or triangular teeth 0.5–1.5 mm. long, the ventral pair commonly broadest, often broader than long, the orifice ± oblique, the whole becoming papery, marcescent unruptured; *petals* whitish, greenish-white, or cream-colored, concolorous; *banner* recurved through 50–85°, variable in outline, most often ovate-cuneate, sometimes elliptic, rhombic-elliptic, or broadly oblanceolate, (10) 11–14.3 (15.5) mm. long, (4.5) 5.4–8.4 (10) mm. wide; *wings* (9) 10–13.4 (15) mm. long, the claws (3.5) 4–5 (6) mm., the oblong-oblanceolate, narrowly obovate, rarely linear-oblong, obtuse or erose, slightly incurved blades (6) 6.5–8 (9.3) mm. long, 1.7–2.5 mm. wide; *keel* (6.7) 7.6–10 (12) mm. long, the claws (3.3) 4.2–5.2 (6.4) mm., the broadly lunate blades (3.7) 4–5.2 (5.9) mm. long, 2.3–3.2 mm. wide, abruptly incurved through 95–120° to the deltoid or triangular, obtuse or subacute, often beaklike apex; *anthers* 0.55–0.7 (0.8) mm. long; *pod* pendulous, stipitate, the filiform, straight or downwardly arched, always puberulent stipe (6) 9–16 mm. long, the body narrowly oblong, linear-oblong, or -elliptic in profile, 1.7–3 cm. long, (3) 3.5–6 (6.5) mm. wide, straight or nearly so, cuneately contracted at both ends or acuminately tapering at base, apiculate distally, the sutures commonly parallel, more rarely the dorsal one straight and the ventral one low-convex, the whole strongly compressed, bicarinate by the filiform, often brownish sutures, the faces at first flat, becoming somewhat distended (low-convex) by the ripening seeds, the pale green, glabrous or strigulose valves becoming papery, stramineous, finely cross-reticulate, not inflexed; *ovules* (11) 13–19 (22); *seeds* pale or reddish-brown, smooth but dull, 2.6–3.1 mm. long.—Collections: 217 (xviii); representative material cited in the discussion.

Dry hillsides, rolling plains, and valley floors, in sandy, loamy or gravelly soils, commonly on basalt, occasionally on granitic or sedimentary bedrock, 250–8000 feet, widely dispersed and sometimes exceedingly abundant locally in the sagebrush zone over a large northwestern segment of the Great Basin northward from the White Pine Mountains and the headwaters of the Reese River in Nevada, west to the Klamath and Pit Rivers in northeastern California, north through transmontane Oregon to the Columbia Basin in interior Washington, east around the edge of the Snake River Plains to Clark and Cassia Counties, Idaho; apparently somewhat isolated along the Nicola River between Spence's Bridge and Merritt, southern British Columbia; also disjunctly in scattered stations in the mountains of interior southern California (Mt. Piños; north slope of San Bernardino Moun-



Map No. 31. Right, western North America in lat. 30–53° N. Range of *A. filipes*. Lower left, the northeast corner of California and adjoining Oregon. Range of ◆ *A. inversus*; and of ▲ *A. californicus*. Upper left, course of the Snake River between Oregon and Idaho. Range of *A. Cusickii*: ▼ var. *Cusickii*; and ◆ var. *flexilipes*.

tains; west slope of Santa Rosa and San Jacinto Mountains) and northern Baja California (Sierra Juárez).—Map No. 31.—May to July.

ASTRAGALUS FILIPES (with threadlike stipe) Torr. ex Gray in Proc. Amer. Acad. 6: 226. 1864.—"Interior of Washington Territory, near Fort Okanagan, Dr. Pickering in coll. Expl. Exped."—Holotypus, 2 sheets: a) labeled "N. Branch of the Columbia. Herb. U. S. Expl. Exped.," and b) a fragment accompanying Torrey's ms. description labeled "Dry prairies between Fort Okanagan and the Grand Coulee, Washington Territory," NY! Isotypus, labeled "Int. Oregon," GH!—*Tragacantha filipes* (Torr.) O. Kze., Rev. Gen. 944. 1891. *Homalobus filipes* (Torr.) A. Heller, Muhlenbergia 9: 67. 1913. *Astragalus stenophyllus* var. *filipes* (Torr.) Tidest. in Proc. Biol. Soc. Wash. 50: 20. 1937.

Homalobus stenophyllus sensu Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 249. 1900 & in N. Amer. Fl. 24: 273. 1929; ? an *A. stenophyllus* T. & G., 1838, nom. ambig. *Phaca stenophylla* sensu Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 371. 1906.

Homalobus MacGregorii (Ernest Alexander McGregor, 1880– , entomologist, assistant curator at DS 1906–9) Rydb. in Bull. Torr. Club 50: 270. 1923.—"Near Frazier Borax Mine, Mount Piños, Ventura County, California, June 12–14, 1908, *Abrams & McGregor 219*."—Holotypus, NY! isotypi, DS, G, US!—*Astragalus MacGregorii* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 20. 1937.

Astragalus filipes var. *residuus* (left behind, relict) Jeps., Man. Calif. 571. 1925—"... from the Santa Rosa Mts. (Cahuilla Valley, Jepson 1469, type) to Mt. Piños."—Holotypus, collected in May, 1901, JEPS!—*A. stenophyllus* var. *residuus* (Jeps.) Barneby in El Aliso 2: 203. 1950.

In northern Nevada, southern Idaho, and over much of transmontane Oregon the basalt milk-vetch, *A. filipes*, is one of the few truly common astragali, often occurring in colonies of great extent, sometimes in such quantity as to color the sagebrush hillsides with a wash of creamy, spicily fragrant blossoms. Except in northeastern California, where its range overlaps those of the two immediately related *Inversi* keyed out above, *A. filipes* is the only species in its area of dispersal other than *A. tenellus* (with much smaller flowers and fruits) in which connate stipules are combined with stipitate, laterally compressed, unilocular fruits. Care should be taken in southern California to discriminate between it and *A. trichopodus* var. *phoxus* which has a deceptively similar pod but all stipules free.

Despite an immense latitudinal range of close on twenty degrees (31–51° N.), *A. filipes* is comparatively little variable in features of importance, and the fluctuation in size and shape of the leaflets or in amount and distribution of the pubescence fails to coincide with significant patterns of dispersal. A partial exception to this statement is provided by a pod glabrous or pubescent above the consistently puberulent stipe. A long, if not unbroken tradition has maintained two coordinate entities, shifting from the varietal to the specific level, based chiefly on this character. The typus of *A. filipes* represents, sensu stricto, a particular race of the basalt milk-vetch native to sagebrush scablands at low elevations in eastern Washington. The average plant from this region is relatively slender, with few, commonly diffuse stems, small, scattered, very narrow leaflets cinereous on both sides, and very loosely or remotely racemose, whitish or greenish-white flowers small for the species as a whole and giving rise to fruits pubescent the whole length. (*C. L. Hitchcock 17,492* ID, NY, RSA, WS; *H. T. Rogers 592*, CAS, NY, WIS, WS; *J. W. Thompson 11,665*, CAS, NY, WTU). On the other hand, the picture I have formed of the Great Basin populations of *A. filipes* is typified by a well-furnished clump of many erect and stiffly ascending stems, leaflets mostly linear (rarely broader, exceptionally filiform), more compact fruiting racemes (3–13 rather than 5–23 cm. long), ochroleucous flowers of variable size, and a pod glabrous above the stipe (*Nelson & Macbride 1029*, ID, NY, RM, SMU, WS; *Maguire & Holmgren 26,360*, NY, RSA, TEX, UTC, *25,490, 25,870*, NY, RSA, UTC, WS; *Train 2942*, NA, NY, TEX). While these contrasts hold good in many cases, none of them bear really close scrutiny. For example, plants of the slender northern type isolated in Nicola Valley in British Columbia may bear either glabrous or pubescent fruits (*J. W. & E. M. Thompson 59*, CAS, glabrous, NY, pubescent); and the same type of variation occurs on Mt. Piños in southern California (*M. & G. Ownbey 2986*, CAS, NY, RSA, SMU, WS, glabrous; *C. B. Wolf 11,129*, CAS, NY, pubescent). Furthermore, in the Columbia drainage of northeastern Oregon, especially on the Deschutes and lower John Day Rivers, the prevailing form of *A. filipes* is of the erect southern type but bears pods about as often pubescent as glabrous; and there are a few scattered records of a puberulent pod from the lake country of southeastern Oregon, even from northern Nevada (*Heller 10,631*, CAS, NY). There is sound reason to believe that racial differentiation is actively at work in *A. filipes*, but it is of no practical use to break up the species into subspecific units without a better means of discriminating between them.

Several attempts have been made to maintain a separate taxonomic niche for the populations of *A. filipes* found in four restricted and mutually distant areas in the mountains of southern California and northern Baja California, probably because these are so dramatically disjunct from the main range of the species. The var. *residuus* was supposed originally to differ from *A. filipes* in its oblique pod, with straight ventral and low-convex dorsal sutures. A pod of this sort is found on a few other collections from the San Jacinto Mountains (*Munz 15,125,* CAS), but it is not characteristic of all southern Californian material and occurs sporadically also in the Great Basin. I look back with perplexity at my statement (1950, l. c.) that *A. stenophyllus* var. *residuus* could be distinguished from the typical sort by more densely pubescent foliage and strigulose pod, for neither point is true of the majority of specimens that I have examined since. The typus of *Homalobus MacGregorii* has glabrous fruits combined with leaflets pubescent both above and beneath, but this combination of pubescence-characters is only one of several present in southern California, and all can be matched in fine detail with material from the Great Basin. As a last instance of variation in vesture, I must cite a collection from northern Baja California (*Harbison 44,793,* RSA) which includes examples of leaflets either glabrous or pubescent above. The populations of *A. filipes* at the northern and southern limits of its range are especially plastic as regards the vesture of the pod, and indeed of the whole plant, even though they are isolated in environments hostile to their expansion under contemporary climatic conditions. They have the appearance of relicts contradictorily rich in biotypes.

The Basin type of *A. filipes* with pod ordinarily glabrous has passed in recent monographs and in most of the floristic literature of the past fifty years under the name *A. stenophyllus* T. & G., and rejection of the latter in favor of the later *A. filipes* requires explanatory comment. The name *A. stenophyllus* T. & G., 1838, originated as a legitimate substitute for the later homonym *A. leptophyllus* Nutt., 1834, and is based on material collected by Nathaniel Wyeth somewhere in western Montana or eastern Idaho during the early summer of 1833. The Wyeth specimens at PH near Nuttall's label *"Astragalus *leptophyllus.* Heads of the Missouri." to which is added in an old hand, not Nuttall's, "Nutt. from Wyeth." The duplicate in the Torrey herbarium (NY) bears the further annotation "June 16," a potentially significant date to which I shall return in a moment. These two sheets and the duplicate at BM consist of several stems, all severed well above the base and bearing racemes of flowers at full and early anthesis. In my opinion they might with equal probability represent either one of two species, *A. filipes* or *A. (Reventi-arrecti) atropubescens.* The latter is quickly distinguished in normal circumstances by its free lower stipules and erect, trigonously compressed, fully bilocular pod, but every diagnostic feature is lacking from the typus of *A. leptophyllus.* According to Gray the ovary of Wyeth's plant is unilocular, but I find a like ovary in genuine *A. atropubescens* at the same immature stage, the septum apparently developing pari passu with the exterior walls of the fruit. Even if the specimens are indecipherable of themselves, it might seem possible to establish their identity by comparison of what is known of Wyeth's route with the ranges of the two species in question, but here again we run into difficulties. The pertinent segment of Wyeth's journey (as described by McKelvey, 1955, p. 513) extends from the middle of May, when he was traveling southward up the Bitterroot River in what is now Ravalli County, Montana, to mid-June, when he reached the floor of the Snake River Plains by way of the valley of the Little Lost River in eastern Idaho. Within this period Wyeth had crossed the Anaconda Range near Gibbons Pass and descended into the Big Hole Basin, the one and only point, it may be noticed, where he actually touched upon the "Heads of the Missouri." Turning west from the Big Hole, he had crossed the Bitterroots and, having reached the Salmon River near the mouth of the Lemhi, had continued south up the Salmon and the Pahsimeroi to the head of the Little Lost. At this point, on the Pahsimeroi-Little Lost divide, Wyeth passed out of the known range of *A. atropubescens* into that of *A. filipes,* and he clearly had opportunities of collecting either species. If Nuttall's label at PH is to be interpreted literally, the typus of *A. leptophyllus* was probably collected on the Big Hole in Beaverhead County, Montana, and can only represent *A. atropubescens.* If the date on the ticket at NY is correct and Wyeth reached the Snake River Plains by the middle of June, the typus was probably collected in the valley of Little Lost River on the way down to the Snake, and can then be identified with some assurance as *A. filipes.* In ordinary years it would be difficult to find plants of *A. filipes* in such young flower as late as June 16, but no record is available of local conditions in the spring of 1833. The best that can be said of *A. leptophyllus,* unless a more complete specimen exists, is that its typus might be interpreted with about equal justice in the sense of either species, and the name can properly be discarded as a potential source of error and continuing controversy. The specific epithet was first associated with the glabrous-fruiting phase of *A. filipes* by Rydberg in his *Flora of Montana* (1900, l.c.), at a time when *A. atropubescens* was very poorly known. If Rydberg guessed aright—and he was influenced, I suspect, by herbarium annotations of

E. P. Sheldon—the plant was surely not from Montana. If the plant was from Montana, the guess was wrong. There is no obligation to respect a tradition based on such nebulous data. Cf. also Appendix I, No. 6.

84. Astragalus inversus

Slender, diffuse, sparsely leafy and somewhat junceous, with a woody taproot and shallowly subterranean, shortly forking caudex or knotty root-crown, thinly strigulose with fine, straight, appressed or narrowly ascending hairs up to 0.3–0.5 mm. long, the stems and herbage green or greenish, the leaflets usually pubescent on both sides, sometimes more thinly so or rarely glabrous above; *stems* several or numerous, widely spreading or prostrate, 2–5 dm. long, naked and simple at base, divaricately branched from 1–4 axils preceding the first peduncle, zigzag distally, together forming loosely woven mats; *stipules* 1.5–5 mm. long, dimorphic, those at the subterranean and first emersed nodes amplexicaul and connate into a papery-membranous, subtruncate or bidentate sheath, the median and upper ones herbaceous, either semiamplexicaul and free or fully amplexicaul and united by a low collar around the stem, with spreading or abruptly deflexed, triangular or triangular-acuminate free blades; *leaves* (3) 5–12 cm. long, all shortly petioled, with slender rachis and 5–11 remote, linear, linear-oblanceolate, -elliptic, or filiform, acute or subacute, mostly involute and retrorsely arched leaflets (2) 5–25 mm. long, those of the upper leaves commonly reduced in size, number, or both, occasionally wanting, the terminal one continuous with or obscurely jointed to the rachis; *peduncles* divaricate and incurved, (2) 4–20 cm. long; *racemes* very loosely (3) 5–15 (22)-flowered, the flowers ascending in early anthesis, then spreading and at last declined, the axis becoming (1.5) 2–10 cm. long, the fruits commonly secund; *bracts* submembranous, ovate-acuminate or lanceolate, 1–2.5 mm. long; *pedicels* slender, at anthesis ascending, straight, 0.6–1.5 mm. long, in fruit spreading, arched outward, or contorted around the axis and thence dejected, 0.8–3 mm. long; *bracteoles* 0–2, minute scales when present; *calyx* 3.5–5 mm. long, strigulose with white or black and white hairs, the subsymmetric disc 0.7–1.1 mm. deep, the reddish tube 3–4 mm. long, 2.3–2.8 (3.1) mm. in diameter, the broadly subulate or triangular, mostly obtuse teeth 0.6–1 mm. long, the ventral pair commonly shortest, the orifice ± oblique, the whole marcescent unruptured; *petals* pinkish-red with darker red veins, the banner tipped with white and the keel and wings with buff-yellow; *banner* gently recurved through 35–45°, ovate-cuneate or oval-elliptic, shallowly emarginate, 9.4–12.2 mm. long, 4.5–6.4 mm. wide, the blade fleshy-thickened in the fold; *wings* only slightly shorter, 8.5–11.6 mm. long, the claws 3.2–3.7 mm., the broadly oblanceolate or narrowly oblong, truncate-erose or emarginate, slightly incurved blades 5.9–7.7 mm. long, 1.7–3 mm. wide; *keel* 8.2–10 mm. long, the claws 3.3–3.9 mm., the obliquely triangular-lanceolate blades 5.1–6.5 mm. long, 2.1–2.8 mm. wide just above the base, thence tapering upward and gently incurved through 40–85° to the subulate, beaklike but ultimately obtuse apex; *anthers* 0.55–0.75 mm. long; *pod* pendulous (appearing horizontal from divaricate or humistrate peduncles), stipitate, the straight, slender stipe (4) 6–14 (16) mm. long, the body linear-oblong or -lanceolate in profile, (1.5) 1.8–3.5 cm. long, 3–4.5 mm. in diameter, straight or a little arched downward, shortly acuminate at both ends, strongly compressed, 2-sided, bicarinate by the filiform but salient sutures, the faces low-convex at maturity, the thinly fleshy, mottled valves becoming papery, brownish or stramineous, strigulose with incumbent hairs or glabrous beyond the puberulent stipe, not inflexed; *ovules* 13–17; *seeds* (seldom seen) about 2.5 mm. long.—Collections: 11 (ii); representative: *J. T. Howell 13,167* (CAS, POM), *12,388* (CAS); *Ripley & Barneby 5740* (CAS, NY, GH, UTC), *5749* (CAS, NY, RSA).

Plains and thinly wooded hills, in dry stony basaltic or pumice soils, among sagebrush or in xeric pine forest, 4000–6000 feet, apparently uncommon (but easily overlooked), known only from northeastern California, from eastern Siskiyou and northeastern Shasta to western Modoc and southern Lassen Counties. —Map No. 31.—June to August.

ASTRAGALUS INVERSUS (inverted, the pod often slightly decurved and appearing upside down) Jones in Zoë 4: 276. 1893.—"Susanville, California, July 1, 1892, Brandegee."—Holotypus, collected by T. S. Brandegee, July 1, 1893, UC! isotypi, CAS, POM (fragm.)!—*Homalobus inversus* (Jones) Rydb. in Bull. Torr. Club 50: 271. 1923. *Astragalus filipes* var. *inversus* (Jones) Jeps., Man. Calif. 571. 1925.

The Lava Beds milk-vetch, *A. inversus,* has many technical characters in common with *A. filipes,* but it is easily distinguished by the few, scattered or remote leaflets, the curiously shaped keel-petals, and the mottled pod. Its sparsely leafy, somewhat rushlike growth-habit is likely to recall *A. convallarius* of sect. *Genistoidei,* a related group differing in the sessile but similarly compressed pod. The reddish-pink coloring of the petals, which fades off to white toward the tip of the banner and is variegated by yellowish wing-tips, has no match among American *Astragali.*

85. ASTRAGALUS CALIFORNICUS

Commonly robust, but diffuse, with a woody taproot and shortly subterranean root-crown or caudex, villous-villosulous nearly throughout with fine, loosely ascending, spreading and incurved, or curly hairs up to (0.5) 0.6–1.1 mm. long, the herbage greenish-cinereous or canescent, the leaflets equally pubescent on both sides or more thinly so and sometimes medially glabrescent or even glabrous above; *stems* several or numerous, decumbent and ascending in clumps, (1.5) 2–5 dm. long, slender, pallid and leafless at base, becoming stouter and striate upward, simple or bearing spurs or branchlets at 1–3 nodes preceding the first peduncle; *stipules* (1.5) 2–6.5 mm. long, dimorphic, those at the lowest, leafless nodes connate into a closely amplexicaul, papery-scarious (fragile and easily ruptured) sheath, the median and upper ones submembranous, greenish becoming pallid in age, triangular-acuminate or -caudate, semiamplexicaul-decurrent, the margins of the commonly deflexed blades beset with a few clavate processes; *leaves* usually divaricate or recurved, 3–8.5 cm. long, all but the lowest subsessile, with 13–21 (23) narrowly oblong- or cuneate-oblanceolate, truncate-retuse or rarely obtuse, flat or loosely folded leaflets (4) 6–20 (23) mm. long; *peduncles* stiffly erect or incurved-ascending, commonly stout, (3) 6–14 cm. long, nearly always surpassing the leaf; *racemes* at first rather closely, soon loosely (10) 15–25 (30)-flowered, the flowers early spreading and at full anthesis declined or nodding, the axis elongating, 3–10.5 cm. long in fruit; *bracts* membranous or broadly membranous-margined, lanceolate or triangular, (1.5) 2–5 mm. long; *pedicels* densely villous, at anthesis ascending at a wide angle or arched outward, 1.3–2.3 mm. long, in fruit either recurved or straight and divaricate, little thickened, 2.2–3.5 mm. long; *bracteoles* 0–2; *calyx* 6.4–9.7 mm. long, silky-villosulous (especially at base) with white and some black or fuscous hairs, the oblique disc (1.2) 1.4–2.1 mm. deep, the tube obliquely cuneate at base, 5.2–7 mm. long, 3.5–4.5 mm. in diameter, the subulate-triangular or broadly triangular teeth (0.9) 1.2–3 mm. long, the ventral pair sometimes longest, the whole becoming papery, marcescent unruptured; *petals* ochroleucous or yellowish, immaculate; *banner* recurved through ± 45°, obovate-cuneate or rhombic-oblanceolate, (11.5) 13–17.4 mm. long, 6–9.6 mm. wide; *wings* (11) 11.6–14.5 mm. long, the claws 4–6.4 mm., the linear-oblong or oblanceolate, obtuse, subtruncate or obscurely emarginate, slightly incurved blades 6.7–9.1 mm. long, 2–3.4 mm. wide, the inner margins undulate below the middle; *keel* (9.5) 10.1–12.4 mm. long, the claws 4.1–6.3 mm., the lunately half-obovate

or obliquely triangular blades 5.1–6.8 mm. long, 2.5–3.5 mm. wide, incurved through 85–100° to the sharply deltoid apex; *anthers* (0.5) 0.7–1 mm. long; *pod* pendulous, stipitate, the straight, slender stipe 8–14 mm. long, the linear-oblong body 2.7–4.3 cm. long, 3.4–5 mm. in diameter, straight to quite strongly decurved, tapering at base into the stipe, contracted cuneately or acuminately at apex and finally cuspidate, laterally compressed, bicarinate by the cordlike ventral and the more slender, sometimes undulate dorsal sutures, the faces nearly flat when young becoming low-convex at maturity, the thinly fleshy, commonly mottled valves becoming papery, brownish, finely reticulate, densely to quite thinly or minutely strigulose, exceptionally glabrous, not inflexed; *ovules* (15) 19–25 (27); *seeds* brown or olivaceous, purple-speckled, smooth or sparsely pitted, somewhat lustrous, 2.4–3.4 mm. long.—Collections: 20 (v); representative: *T. Howell 1351* (MO, ND, NY, ORE, UC, WS); *L. F. Henderson 12,615* (ORE, WILLU); *Heller 8082* (MO, NY); *Ripley & Barneby 9633* (CAS, NY, RSA); *Barneby 11,510, 11,516* (CAS, NY, RSA).

Dry hillsides, stony ridges, and canyon benches, among sagebrush, in open oak woods, or in openings of coniferous forest, on either metamorphic or basaltic bedrock, 1500–4550 feet, local but forming colonies along the inner foothills of the North Coast Ranges in northeastern California, from the headwaters of the Sacramento River and north base of Mt. Shasta to the upper and middle Klamath River, in Shasta and Siskiyou Counties, extending north in the Siskiyou foothills just into southern Jackson County, Oregon.—Map No. 31.—April to early July.

ASTRAGALUS CALIFORNICUS (Gray) Greene in Bull. Calif. Acad. Sci. 1: 157. 1885. *("Californicus")*, based on *A. collinus* var. *californicus* (of California) Gray in Proc. Amer. Acad. 12: 54. 1876.—"Yreka, California, E. L. Greene."—Holotypus, dated May 9, 1876, GH! isotypi, CAS (*Greene 764*, dated May and June, 1874), MO!—*Homalobus californicus* (Gray) A. Heller, Muhlenbergia 2: 86. 1905.

The Klamath milk-vetch, *A. californicus*, is one of several astragali, native to northeastern California, with ochroleucous flowers of moderate size, but it is the only one with villosulous foliage and stems; and the very long and narrow, straight or decurved pod tapering at base into the long stipe is amply distinctive. Although the species has every technical character of subsect. *Inversi*, opinion has been divided as to its near relationships. It was first described as a variety of *A. collinus* and was maintained in sect. *Collini* by Rydberg (1924, p. 14; 1929, p. 276, as *Homalobus*), whereas Jones alligned it with *A. inversus* and *A. stenophyllus* in the section equivalent to our *Cusickiani*. There is no real suggestion in the flower of the peculiar basally pouched, *Cuphea*-like calyx proper to sect. *Collini*, although the villous pubescence and thickened ventral suture of the pod recall genuine *A. collinus*. It is perhaps transitional between the two groups.

Around the western edge of the Klamath Basin *A. californicus* is found occasionally in the sagebrush association of the common intermountain type, but its area of greatest vigor and abundance lies in the mixed oak-ceanothus and oak-conifer woodlands of the inner North Coast Range. It is especially common along the Klamath River between Yreka and the mouth of Scott River where it occurs (at about 1500 feet) on metamorphosed granites and serpentines, associated with a local race of *A. Purshii* var. *tinctus*.

XIX (ii). Subsectio CUSICKIANI

Root-crown determinate, superficial, aerial, or subterranean; *vesture* basifixed; terminal *leaflets* commonly jointed, rarely confluent; *pod-body* bladdery-inflated, subsymmetrically balloon-shaped, obliquely obovoid, or half-ellipsoid.—Spp. 2, of interior Washington, Oregon, Idaho, and northern Nevada, and of the North Coast Range and Sierra Nevada in California south to Mt. Piños.

ASTRAGALUS sect. CUSICKIANI (Rydb.), comb. nov., based on *Phaca* subgen. *Podocystis* sect. *Cusickianae* Rydb. in N. Amer. Fl. 24: 338. 1929.—Sp. typica: *P. Cusickii* (Gray) Rydb. = *A. Cusickii* Gray.

Astragalus sect. *Inflati* subsect. *Hookeriani* Jones, Rev. Astrag. 95, in clave. 1923.—Sp.

typica: *A. Hookerianus* (T. & G.) Gray = *A. Whitneyi* var. *Sonneanus* (Greene) Jeps.—*Phaca* subgen. *Podocystis* sect. *Hookerianae* (Jones) Rydb. in N. Amer. Fl. 24: 339. 1929.

Key to the Species of Subsect. Cusickiani

1. Stems relatively tall, 3–7 dm. long; *pod* variable in outline, subsymmetrically obovoid to half-ellipsoid, but always contracted below the apex into a discernibly differentiated, laterally compressed beak; *leaflets* linear, remote, those of some upper leaves commonly reduced in size, number, or both; *root-crown* or caudex superficial or aerial; canyons of the Snake and lower Salmon Rivers and of tributary creeks along the Oregon and Idaho boundary ..... 86. *A. Cusickii*
1. Stems shorter, up to 3, rarely 4 dm. long; *pod* symmetrically balloon-shaped, broadest just below the beakless apex and tapering downward into the stipe; *leaflets* mostly broader than linear, not reduced in size or number in any upper leaves; *root-crown* often buried, sometimes superficial; widespread from Washington to California, n. Nevada, and s.-centr. Idaho, but absent from the range of *A. Cusickii* along the Oregon-Idaho boundary ..... 87. *A. Whitneyi*

86. Astragalus Cusickii

Slender but rather tall, sparsely leafy and often rushlike, with a thick woody taproot and at length shortly forking caudex, thinly strigulose with straight, appressed hairs up to 0.3–0.5 mm. long, the green, striate stems glabrous or nearly so, the leaflets green, either glabrous or strigulose above; *stems* several or numerous, erect and ascending in bushy clumps, rarely diffuse or pendulous from cliff-ledges, 3–7 dm. long, paniculately branched from near the base, or at least at several nodes preceding the first peduncle; *stipules* (0.5) 1–4.5 mm. long, the lowest early becoming papery, at least in vernation fully amplexicaul and connate into a subentire or bidentate sheath (commonly ruptured by expansion of the stem and then appearing as a low, imperfectly amplexicaul collar), the median and upper ones small, inconspicuous, united by a stipular line or only semiamplexicaul, with erect, triangular or subulate, herbaceous blades; *leaves* commonly divaricate and incurved, 4–10 (13) cm. long, with slender, tapering rachis and (5) 7–15 (17) distant, linear or linear-filiform, acute, subobtuse, involute, or (in some lower leaves) linear-oblanceolate and retuse, flat leaflets 2–22 mm. long, those of the upper leaves usually reduced in size, number, or both, and the terminal one either jointed like the lateral or confluent with the rachis; *peduncles* slender, erect or incurved-ascending, 5–15 (22) cm. long; *racemes* loosely (3) 4–14 (18)-flowered, the flowers early spreading and then declined, the axis 1–8.5 cm. long in fruit; *bracts* submembranous, ovate or subulate, 0.8–1.5 mm. long; *pedicels* at anthesis ascending, straight, (1.2) 1.5–2 mm. long, in fruit ascending or arched outward, 1.5–3.5 mm. long; *bracteoles* 0, rarely a minute scale; *calyx* 4–6.7 mm. long, minutely strigulose with black or mixed black and white hairs, the subsymmetric disc 0.7–1.5 mm. deep, the tube 3.2–5.8 mm. long, the deltoid or broadly triangular-subulate teeth 0.5–1 mm. long, the whole becoming papery, marcescent unruptured; *petals* white, creamy-white, or purplish; *banner* recurved through ± 40°, 12.5–15.5 mm. long, 5–7.5 mm. wide; *wings* 10.2–14 mm. long, the claws 3.5–6.2 mm., the obovate or oblanceolate, obtuse, slightly incurved blades 7–9.3 mm. long, 2–3 mm. wide; *keel* 8–11 mm. long, the claws 4.1–6 mm., the half-obovate, -obcordate, or lunately elliptic blades 4.3–5.2 mm. long, 2.3–2.9 mm. wide, abruptly incurved through 95–100° to the bluntly deltoid or triangular, often slightly porrect apex; *anthers* 0.45–0.6 mm. long; *pod* loosely pendulous, stipitate, the filiform, purplish, sometimes puberulent stipe ± twice as long as the calyx, the body obliquely obovoid, half-obovoid or -ellipsoid, bladdery-inflated, (1.6) 2–4.8 cm. long, (5) 6–16 (when pressed, apparently up to 22) mm. in diameter, commonly broadest above the middle, contracted distally into an oblique, deltoid or deltoid-apiculate beak, the filiform, often purplish ventral suture varying from

strongly convex to straight or a trifle concave in profile, the papery-membranous, subdiaphanous, delicately reticulate, glabrous valves at first pale green, sometimes faintly mottled, becoming stramineous or pearly-white and lustrous, not inflexed; *ovules* 10–20; *seeds* brown, sometimes purple-speckled or -mottled, smooth but scarcely lustrous, 2.9–3.5 (4) mm. long.

The Cusick milk-vetch is virtually endemic to the great troughs formed by the passage of the Snake and lower Salmon Rivers through the mountains along the Oregon-Idaho boundary, but even in this quite restricted area of dispersal it has become racially modified. The canyons of the two main streams are so deeply entrenched that even where they flow in approximately parallel directions and approach each other within seven or eight miles, the intervening ridges form an effective barrier to such plants as *A. Cusickii* which are confined to the banks and terraces immediately above the valley floor. This physical isolation has played a decisive role in shaping the evolution of *A. Cusickii* var. *flexilipes* along the lower Salmon River. At the present time the mouth of the Salmon provides the one point of contact between var. *Cusickii* and var. *flexilipes,* and it is interesting to find that near the confluence of the two streams, and thence downstream to the mouth of the Grande Ronde, the ideal differential characters of the two varieties are variably and perplexingly combined, so that it becomes possible to assemble an uninterrupted series of individual variants ranging from almost perfect var. *flexilipes* with white flowers to a coarse, large-flowered var. *Cusickii* with strongly inflated but oblique legume. The following key is ineffective in this area.

Key to the Varieties of A. Cusickii

1. Stems mostly 3–4 dm. long; *leaflets* (5) 7–11 (13), nearly always strigulose above, often more densely so above than beneath; *calyx* 5–6.7 mm. long; *pod* broadly obovoid, obovoid-ellipsoid, or rarely half-ellipsoid, (1) 1.2–2.2 mm. wide when flattened by pressing; Snake River canyon and streams affluent from the w., e. Oregon, immediately adjoining Idaho, and extreme s.-e. corner of Washington ..... 86a. var. *Cusickii*

1. Stems more slender and taller, 3.5–7 dm. long; *leaflets* 9–15 (17), glabrous above; *calyx* 4–5.1 mm. long; *pod* half-obovoid or -ellipsoid, the ventral suture straight or a trifle concave in profile, 0.6–1.2 cm. wide when flattened; lower Salmon and Little Salmon Rivers, Idaho and Adams Counties, Idaho ..... 86b. var. *flexilipes*

86a. Astragalus Cusickii var. Cusickii

Stipules at base of the stems evidently connate, the sheath ruptured only in age, the median and upper ones usually united by a stipular line, only the uppermost free; *calyx-tube* 4.4–5.8 mm. long, 3–4 mm. in diameter, the disc 1–1.5 mm. deep; *petals* white or creamy-white, concolorous; *banner* rhombic-elliptic, mostly 14–15.5 mm. long; *keel* 9.7–11 mm. long; *stipe* of the pod 3–5 (6) mm. long, the *body* (2) 2.5–4.8 cm. long, the papery-membranous valves not mottled, turning stramineous when ripe; *ovules* 10–20.—Collections: 38 (ii); representative: *Jones 6238* (NY, POM, TEX); *Constance, Rollins & Dillon 1587* (CAS, ORE, POM, WIS, WS, WTU); *Maguire & Holmgren 26,630* (CAS, NY, RSA, UTC, WS); *Peck 16,086* (WILLU, WS), *26,037* (CAS, RSA, WS); *Cronquist 6519* (ID, NY, SMU, WS).

Steep rocky and gravelly clay slopes and canyon terraces, sometimes hanging out from ledges or crevices of basalt cliffs, 1600–3000 feet, locally abundant and not uncommon along the Snake River and streams affluent from the west, from lower Sucker Creek, Malheur County, Oregon, downstream to the mouth of the Grande Ronde River, Asotin County, Washington.—Map No. 31.—May to July.

Astragalus Cusickii (William Conklin Cusick, 1842–1922, pioneer botanical collector in n.-e. Oregon) Gray in Proc. Amer. Acad. 13: 370. 1878.—"Union Co., in the western [properly eastern] part of Oregon, Wm. C. Cusick, comm. by G. O. Woolson."—Holotypus, *Cusick 68* in 1877, GH! isotypi, K (dated 1878), P!—*Phaca Cusickii* (Gray) Rydb. in Bull. Torr. Club 40: 47. 1913.

The typical variety of the Cusick milk-vetch is a handsome astragalus at all stages of growth, the mature plants forming large clumps of erect and ascending, sparely leafy (or at

first sight apparently leafless) stems which bear aloft a mass of ochroleucous or almost clear white flowers; these are followed by the pendulous, transparent bladders of the fruit. At early anthesis some phases greatly resemble the more junceous forms of *A. filipes,* but such as are most likely to be confused with *A. Cusickii* may be distinguished by the pubescent ovary. Except for a small area along the lower Malheur River and Sucker Creek in Malheur County, Oregon, the two species occupy mutually exclusive ranges.

86b. Astragalus Cusickii var. flexilipes

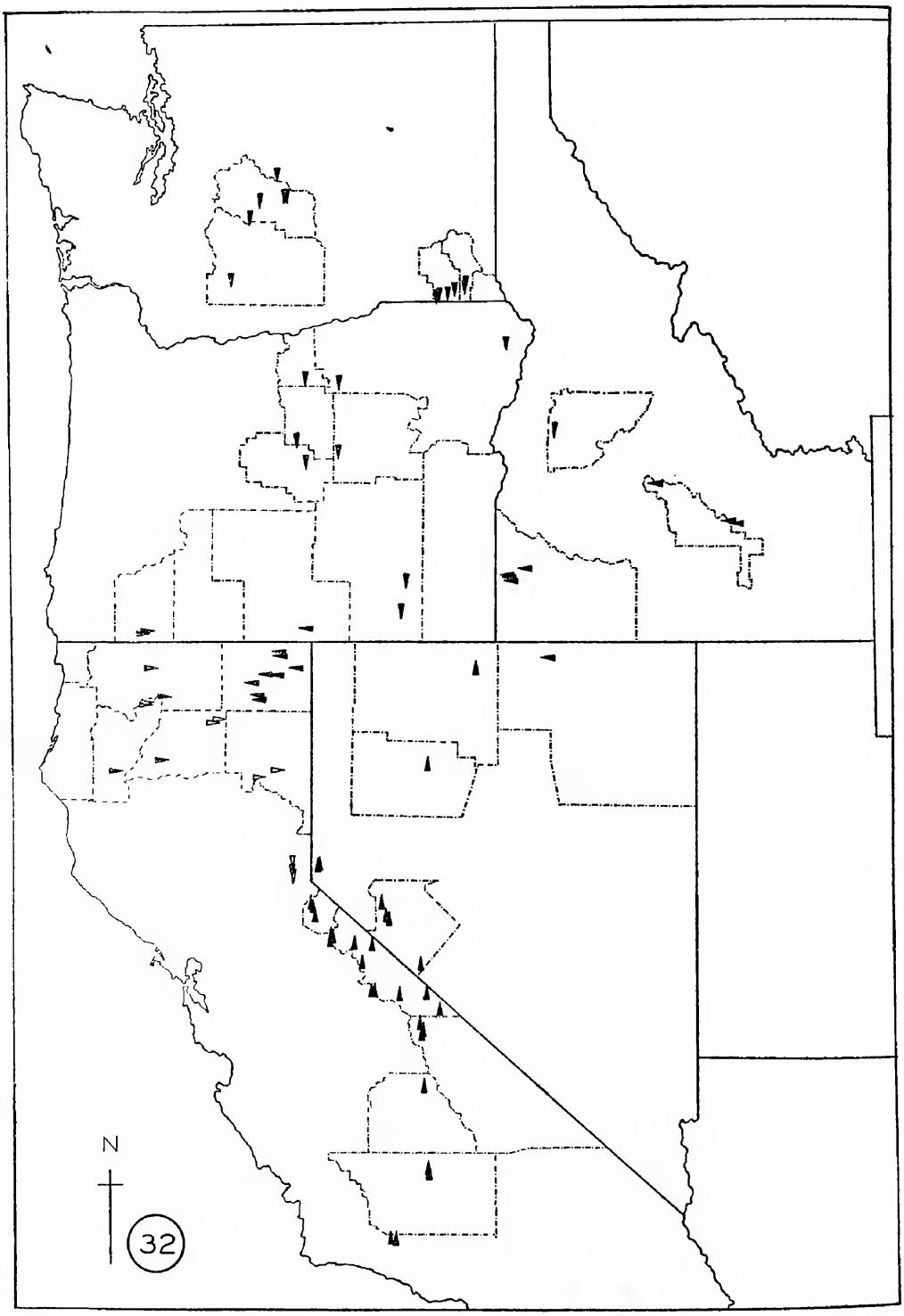
Usually taller and more slender than var. *Cusickii; stipules* at base of all but the slenderest stems connate in vernation only, early ruptured, later appearing as a low, imperfectly amplexicaul collar, the median and upper ones nearly always free from the first; *racemes* (3) 6–14 (18)-flowered, the axis 2.5–8.5 cm. long in fruit; *calyx-tube* 3.2–4.4 mm. long, 2.3–2.8 mm. in diameter, the disc 0.7–1 mm. deep; *petals* commonly pale purple, purplish-tinged, or at least with maculate keel-tip, exceptionally all white; *banner* mostly ovate-cuneate, 12.5–15.5 mm. long; *keel* 8–10 mm. long; *stipe* of the pod (4) 5–8 mm. long, the *body* 2–3 (3.5) cm. long, the delicately membranous valves often faintly mottled; *ovules* 10–16.—Collections: 17 (ii); representative: *M. & G. Owenby 2754* (CAS, NY, RSA, SMU, WS); *Christ & Ward 7287, 7694* (ID, NY); *Christ 15,887, 16,589* (ID, NY); *W. H. Baker 11,952* (ID, RSA).

Habitats of var. *Cusickii,* 1200–1800 feet, locally abundant in the canyon of the lower Salmon River in Idaho County, Idaho, ascending the Little Salmon River just into northern Adams County.—Map No. 31.—May to July.

Astragalus Cusickii var. flexilipes (with pliant stipe) Barneby in Amer. Midl. Nat. 55: 485. 1956.—"Idaho. Little Salmon River canyon, 3 miles north of Pollock, Idaho Co., 14 June, 1951, *Ripley & Barneby* No. 10709 . . ."—Holotypus, CAS! isotypi, NY, WS!

87. Astragalus Whitneyi

Variable in stature, usually low, slender, diffuse and ascending, less often moderately tall and stout, with a thick, woody taproot and nearly always shallowly buried root-crown or caudex, densely to sparsely pubescent with appressed, incurved-ascending, or rarely spreading hairs up to (0.3) 0.35–0.8 mm. long, the herbage greenish, cinereous, or silvery-canescent, the leaflets glabrous, medially glabrescent, or densely hairy above; *stems* several or numerous, 2–30 (40) cm. long, leafless and purplish at base, commonly branched or spurred at 1–4 nodes preceding the first peduncle, sometimes simple, flexuous or zigzag distally; *stipules* 1–5 mm. long, all or at least those at the lowest nodes papery, pallid, purplish or brownish, connate into a loose, cuplike, or shallowly bidentate sheath, the median ones often united only at base or through half their length, the uppermost sometimes only semiamplexicaul, with subherbaceous, triangular, often reflexed blades; *leaves* 1.5–10 cm. long, shortly petioled, with (5) 9–21 oblong-oblanceolate, elliptic, or narrowly obovate, obtuse, or sometimes linear-elliptic and subacute, flat, folded, or involute leaflets 2–21 mm. long; *peduncles* incurved-ascending or erect, 1–9.5 (12) cm. long; *racemes* loosely (3) 4–16-flowered, the flowers spreading and ultimately declined, the axis not greatly elongating, 0.5–7 cm. long in fruit; *bracts* papery or early becoming so, ovate-triangular or lanceolate, 1–3 mm. long; *pedicels* at anthesis slender, ascending, (0.5) 0.8–1.3 mm. long, in fruit a trifle thickened, arched outward, 1–2.5 mm. long; *bracteoles* usually 0, rarely 1–2 minute scales; *calyx* 4.5–9.3 mm. long, pubescent like the herbage with white, partly fuscous, or partly black hairs, the subsymmetric disc 0.7–1.6 mm. deep, the submembranous, campanulate tube 3.5–5.9 mm. long, (2) 2.3–4.5 mm. in diameter, the broadly subulate or obtusely triangular teeth 0.5–3.6 mm. long, the orifice often oblique, the whole becoming papery, marcescent unruptured; *petals* ochroleu-



Map No. 32. Western United States. Range of *A. Whitneyi*: ▲ var. *Whitneyi*; ◗ var. *siskiyouensis* (◊ intergrades to var. *confusus*); ◖ var. *confusus*; ▽ var. *lenophyllus*; and ▼ var. *Sonneanus*.

cous, pinkish-white, lilac, or pink-purple, the wing-tips often paler than the banner, the color fugacious on drying; *banner* recurved through 50–80°, obovate- or ovate-cuneate, sometimes subrhombically so, notched, 8.3–16.2 mm. long, 5.3–10.2 mm. wide; *wings* 7–15 mm. long, the blades narrowly oblong-elliptic, oblong, or oblanceolate, obtuse or erose-emarginate, both gently incurved but the left one more abruptly so and its inner margin infolded; *keel* 7.3–13.8 mm. long, the blades lunately lanceolate or half-ovate, gently incurved through 50–95° to the narrowly triangular, acute or subacute, often slightly porrect apex; *anthers* (0.4) 0.45–0.75 (0.8) mm. long; *pod* pendulous, stipitate, the slender stipe 2–9 mm. long, the bladdery-inflated, balloon-shaped body 1.5–6 cm. long, 1–2.5 (when pressed, apparently to 2.9) cm. in diameter, widest shortly below the obtuse, subsymmetric, beakless apex, tapering downward into the stipe, terete or shallowly sulcate along the subfiliform sutures, the papery, usually brightly red- or purple-mottled, glabrous or strigulose valves becoming stramineous (between the blotches), lustrous, delicately reticulate, not inflexed, the funicular flange 0.2–0.8 mm. wide; *ovules* (13) 15–30 (37); *seeds* brown, greenish- or purplish-brown, sometimes purple-speckled, dull, 2–3.3 mm. long.

The balloon milk-vetch is a species of wide, discontinuous distribution which has become adapted to a variety of environmental and climatic conditions. In the process it has evolved into a number of geographic races often difficult to define in exact contrasting terms, but as a whole well marked by characters of stature, growth-habit, pubescence, and size of the flowers. The pod of *A. Whitneyi* remains essentially uniform throughout the species, although it is quite variable in size and in length of stipe within the limits of each variety. The present account follows, except for some small but important alterations to the key, a revision already published (Barneby, 1950, p. 204–7).

Key to the Varieties of A. Whitneyi

1. Ovary and pod glabrous (2)
   2. Plants of the Sierra Nevada, California, and some isolated ranges in n. Nevada, in California not n. of Nevada County; *racemes* comparatively compact, the fruiting axis 1–4 (4.5) cm. long; *petals* purple or purple-tinged (fading quickly in dried specimens); *pod-body* commonly 1.5–3, rarely 4 (average ± 2.5) cm. long (3)
      3. Pubescence of the herbage strigulose, the hairs appressed or narrowly ascending, straight or subsinuous, up to 0.3–0.55 mm. long; *leaves* mostly 3–11 cm. long, the leaflets not greatly crowded, the blades of narrow outline; in the Californian Sierra s.-ward from Alpine County, n.-e. only in Nevada ..... 87a. var. *Whitneyi*
      3. Pubescence of the herbage hirsutulous, the stiff, mostly straight hairs spreading and ascending, up to 0.5–0.7 mm. long; *leaves* mostly 2–4 cm. long, the leaflets crowded along the rachis, the outline of the blades short and broad; Sierra Nevada in Nevada and Placer Counties, California ..... 87b. var. *lenophyllus*
   2. Plants of the North Coast Ranges in California and s.-w. Oregon, passing in the Klamath Basin into var. *confusus; racemes* looser, the fruiting axis mostly 3–7 long; *petals* (so far as known) ochroleucous; *pod-body* commonly longer, mostly 2.5–6 (average ± 3.5) cm. long. Pubescence variable; leaflets well-separated ..... 87c. var. *siskiyouensis*

1. Ovary and pod strigulose (4)
   4. Racemes relatively short and compact, the axis 0.5–2 (2.5) cm. long in fruit; *flowers* small, the calyx 4–6 mm. long, the keel 7.5–11.2 mm. long; *plants* slender, with prostrate or diffuse stems rarely over 1.5 dm. long and leaves 1.5–4 cm. long; Cascade and Blue Mountains of Washington s. through n.-e. and e.-centr. Oregon to Steens Mountains, Harney County, e. to Valley County, w.-centr. Idaho ..... 87d. var. *Sonneanus*
   4. Racemes usually longer, the axis mostly 1.5–4 cm. long in fruit; *flowers* larger, the calyx (5.5) 6–7.5 mm. long, the keel (11.2) 11.8–13.8 mm. long; *plants* relatively coarse and robust, with mostly erect and ascending stems up to 1–3 dm. long at maturity and leaves 3–10 cm. long; n.-e. California and adjoining Oregon to n.-e. Nevada and s.-w. and s.-centr. Idaho ..... 87e. var. *confusus*

87a. Astragalus Whitneyi var. Whitneyi

Low and diffuse, erect only when supported by sagebrush, the stems 0.5–2.5 dm. long; *herbage* strigulose with appressed or narrowly incurved-ascending, straight or subsinuous hairs up to (0.3) 0.35–0.55 mm. long, green to silvery-canescent, the leaflets either glabrous or pubescent above; *leaves* (1.5) 3–8.5 (11) cm. long, the 9–17 (19) leaflets not crowded, 2–13 (15) mm. long; *racemes* (3) 5–15-flowered, the axis 1–4 (4.5) cm. long in fruit; *calyx* 4.5–6.4 mm. long, the tube (3.5) 3.7–4.2 (4.7) mm. long, (2) 2.5–3.7 mm. in diameter, the teeth 0.8–1.5 (1.8) mm. long; *petals* lilac or pink-purple, the wing-tips pale or white; *banner* (8.3) 10–14.2 (16.5) mm. long, (5.3) 6–9.6 mm. wide; *wings* as long or up to 2.3 mm. shorter, (7) 9–13.6 (14.3) mm. long, the claws (3.2) 4.2–5.8 (6.1) mm., the blades (4.2) 6–9.4 mm. long, (1.7) 2–3.4 mm. wide; *keel* 0–2.5 (3.5) mm. shorter (exceptionally a trifle longer) than the banner, ± equaling the wings, the claws (3.2) 3.7–5.6 (6) mm., the blades (4.2) 5.5–7.2 (7.7) mm. long, (2.1) 2.5–3.3 (3.5) mm. wide; *stipe* of the pod 2–4.5 mm. long, the glabrous *body* 1.5–3, exceptionally up to 3.5 (4) cm. long, 1–1.8 (when pressed up to 2.2) cm. in diameter; *ovules* 18–30—Collections: 46 (iv); representative: *Duran 3365* (CAS, NY, OB, WIS, WS); *Wiggins & Rollins 571* (CAS, TEX, WS); *J. T. Howell 27,029* (CAS, ID, RSA); *M. & G. Ownbey 2788* (CAS, NY, RSA, SMU, WS); *Alexander & Kellogg 4412* (NY, TEX, WS); *A. A. Heller 9937* (CAS, NY).

Stony or sandy slopes and ridges at and above timber line, descending in open places, on talus, and on rock slides into the higher sagebrush valleys and foothills, (6800) 7200-12,000 feet, common and locally abundant along the crest and east slope (rarely just west of the crest) of the Sierra Nevada, from Alpine County south to the head of Owens Valley, Inyo County, California, extending east to the White Mountains and to the Wassuk Range in Mineral County, Nevada; somewhat isolated to the south on the summits of the Piute Mountains, Kern County, and of Mt. Piños, Ventura County, California; and to the north on scattered peaks (Mt. Rose, Washoe County; West Humboldt Mountains, Pershing County; Santa Rosa Mountains, Humboldt County) of northwestern Nevada.—Map 32.—May to September.

Astragalus Whitneyi (Josiah Dwight Whitney, 1819–1896, director of the California Geological Survey) Gray in Proc. Amer. Acad. 6: 526. 1865.—"On the same mountain with the preceding species," i.e., "Dry rocky mountain near Sonora Pass . . . in loose soil, near the summit, alt. 10,000 feet."—Holotypus, collected by G. H. Brewer in 1863, wrongly dated "1866," GH! isotypi, K, P, US!—*Tragacantha Whitneyi* (Gray) O. Kze., Rev. Gen. 949. 1891. *A. Hookerianus* var. *Whitneyi* (Gray) Jones in Proc. Calif. Acad. Sci. II, 5: 668. 1891. *Phaca Whitneyi* (Gray) A. Heller, Muhlenbergia 9: 67. 1913.

Astragalus Whitneyi var. *pinosus* (of Mt. Piños) Elmer in Bot. Gaz. 39: 54. 1905.—"Summit of Mt. Piños, Ventura County, California, July, 1902. Type specimen, no. 4005, in Herb. Stanford University."—Holotypus, from "near Griffin's, Ventura County," DS! isotypus, NY!—*A. Hookerianus* var. *pinosus* (Elmer) Jeps., Man. Calif. 564. 1925. *Phaca pinosa* (Elmer) Rydb. in N. Amer. Fl. 24: 341. 1929.

Phaca argentata (silvery, of the leaves) Rydb. in N. Amer. Fl. 24: 340. 1929.—"Type collected on the west slope of Star Peak, West Humboldt Mountains, Nevada, July 31, 1912, *Heller 10663* . . . "—Holotypus, NY! isotypi, MO, NY, RENO!

Although far from being the first discovered or first described variety of the balloon milk-vetch, var. *Whitneyi* is the most often collected and best-documented form. It cannot be thought primitive in relation to the other varieties, but serves as a convenient protoype or standard of comparison and provides an illustration of the sort of variation to be expected in the species. Usually a low, slender plant which becomes diffuse or prostrate in open places but often grows in the shelter of sagebrush and other dwarf shrubs, it may be recognized by its relatively distant leaflets, short and compact racemes of parti-colored purple and white flowers, and by the glabrous, brightly mottled pod of moderate size, rarely surpassing 3 cm. in length. The variety varies greatly in density of vesture, but the nearly glabrous *Phaca pinosa* and the

silvery-strigulose *P. argentata,* phases which become more frequent to the south and north, respectively, of the variety's range, are probably best interpresteđ as extreme forms in a continuous series of minor variants.

87b. Astragalus Whitneyi var. lenophyllus

Low, diffuse, the stems 4–15 (20) cm. long; *herbage* densely hirsutulous with rather stiff, ascending or spreading, straight or nearly straight hairs up to 0.5–0.7 mm. long, the leaflets equally pubescent on both sides, gray or silvery; *leaves* (1.5) 2–4 cm. long, the 9–17 leaflets 3–13 mm. long; *racemes* very shortly 5–9-flowered, the axis 0.5–2 cm. long in fruit; *calyx* hirsutulous with white or mixed black and white hairs; *petals* as in var. *Whitneyi,* the color not certainly known (ochroleucous when dry); *pod* glabrous, the stipe 3–5 (7) mm., the body 1.5–3.5 (4.2) cm. long, 1–2 (when pressed up to 2.5) cm. in diameter.—Collections: 13 (o); representative: *Lemmon 67, 68* (NY); *Heller 7101* (NY); *J. T. Howell 18,620, 18,672* (CAS, RSA).

Treeless summits and open stony places in the timber belt, 8800–10,000 feet, known only from near the crest of the Sierra Nevada in Placer and Nevada Counties, California. — Map No. 32. — July and August.

Astragalus Whitneyi var. lenophyllus (Rydb.) Barneby in El Aliso 2: 205. 1950, based on *Phaca lenophylla* (woolly-leaved) Rydb. in N. Amer. Fl. 24: 341. 1929.—"Type collected on Tinker's Knobs, Placer County, California, altitude 9000 feet, July 24, 1892, *Sonne* . . . "—Holotypus, collected in part on July 24, in part in August, 1892, NY!—*A. lenophyllus* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937.

The var. *lenophyllus,* poorly differentiated from var. *Whitneyi,* is nevertheless easily recognized by the congestion along the leaf-rachis of the small, often folded leaflets which are clothed with a dense, comparatively loose and long coat of silvery-gray hairs. Flowers and fruits of the two varieties are essentially identical, but those of var. *lenophyllus* are less variable in size. The variety is dispersed in the Sierra over nearly the same range as *A. (Chaetodontes) Austinae,* although where the latter extends east of Lake Tahoe onto the slopes of Mt. Rose, it is associated with var. *Whitneyi.* The var. *lenophyllus* was first collected somewhere in the Sierra in 1870 by Dr. Kellogg (CAS, DS).

87c. Astragalus Whitneyi var. siskiyouensis

Closely resembling var. *Whitneyi,* averaging a little taller, the stems (1) 1.5–3 (4) dm. long; *herbage* loosely strigulose but in variable amounts, the leaflets glabrous to densely pubescent above, green or canescent, the longest hairs up to 0.4–0.6 (0.7) mm. long; *leaves* 3–9 cm. long, the 9–17 (19) well-separated, narrow leaflets 4–18 (21) mm. long; *racemes* loosely 4–16-flowered, the axis (2) 3–7 cm. long in fruit; *calyx* 4.6–5.6 (6) mm. long, the tube 3.8–4.7 mm long, 2.3–3.5 mm. in diameter, the teeth 0.5–1.5 (1.7) mm. long; *petals* ochroleucous, immaculate; *banner* 9.5–13.5 mm. long, (5.7) 6.4–8 (9) mm. wide; *wings* (0–1.5 mm. shorter than the banner) 9–10.4 (13.5) mm. long, the claws 3.9–5.1 (5.8) mm., the blades 5.4–6 (7) mm. long, 1.9–3 mm. wide; *keel* (0.3–3 mm. shorter than the banner) 8.2–10.8 (12) mm. long, the claws 4.2–5.4 (6) mm., the blades 4.2–5.8 (6.8) mm. long, 2.4–3.1 mm. wide; *pod* glabrous, the stipe 3–6 mm. long, the body (1.5) 2.5–5 (6) cm. long, (0.8) 1–2.2 (when pressed up to 2.5) cm. in diameter; *ovules* (13) 15–22.—Collections: 23 (ii); representative: *W. H. Baker 6222* (ID, NY, RSA, WS); *Heller 12,487* (CAS, NY, WIS, WS); *Eastwood & Howell 5019* (CAS); *Barneby 11,536* (CAS, NY, RSA), *11,555* (CAS, NY, RSA).

Open gravelly or rocky slopes and crests, usually in pine forest but ascending into fir forest, on volcanic or metamorphic bedrock but especially common and abundant on serpentine, (2600) 4100–8800 feet, rather frequent in the inner North Coast Ranges of California from the south foothills of the Trinity Alps to the

Siskiyou Mountains, extending just north into Jackson County, Oregon, and east to the north slope of Mt. Shasta; also (atypically) east along the Pit River in Shasta County, where apparently passing into var. *confusus*.—Map No. 32.—June to August.

ASTRAGALUS WHITNEYI var. SISKIYOUENSIS (Rydb.) Barneby in El Aliso 2: 205. 1950, based on *Phaca siskiyouensis* (of the Siskiyou Mountains) Rydb. in N. Amer. Fl. 24: 340. 1929.—"Type collected on Mt. Eddy, Siskiyou County, California. August 30, 1912, *Alice Eastwood 2006* . . ."—Holotypus, NY! isotypi, CAS, US!—*Astragalus siskiyouensis* (Rydb.) J. W. Thomps. in Leafl. West. Bot. 1: 212. 1936. *A. Hookerianus* var. *siskiyouensis* (Rydb.) Peck, Man. Ore. 446. 1940 & in Madroño 6: 134. 1941. *A. Whitneyi* subsp. *siskiyouensis* (Rydb.) Abrams, Ill. Fl. Pac. St. 2: 583. 1944.

The balloon milk-vetch of the North Coast Ranges, var. *siskiyouensis,* is as variable in pubescence as var. *Whitneyi,* silvery and green forms being known to occur in the same range of mountains although not in the same colony of plants. The supposition (Barneby, 1950, p. 205) that the fresh petals were purplish and the color fugacious in drying was mistaken; fresh flowers, seen since in the Trinity Alps and Scott Mountains, were ochroleucous and immaculate. This may be true of var. *siskiyouensis* everywhere. The variety is otherwise only poorly distinguished from var. *Whitneyi* by its ordinarily taller stems and longer pods disposed in looser and longer racemes. Larger-flowered plants from the Pit River Valley in Shasta County, which I mentioned in my revision (1950, l.c.), are truly purple-flowered and intermediate between var. *siskiyouensis* and var. *confusus,* from which the glabrous pods alone separate them. The variety was first collected in 1876, on Scott Mountain, by E. L. Greene.

87d. ASTRAGALUS WHITNEYI var. SONNEANUS

Low, slender, the prostrate, weakly ascending, or loosely tufted stems 2–12 (17) cm. long; *herbage* loosely strigulose or villosulous with subappressed, spreading and incurved, or incurved-ascending, often sinuous hairs up to 0.3–0.65 mm. long, greenish-cinereous or sometimes canescent, the leaflets pubescent on both sides; *leaves* 1.5–4 cm. long, the (5) 11–17 leaflets 2–10 (12) mm. long, often rather crowded; *racemes* shortly 4–9 (11)-flowered, the axis 0.5–2 (2.5) cm. long in fruit; *calyx* 4.8–6 mm. long, the tube 3.5–4.3 mm. long, (2.2) 2.5–3.3 mm. in diameter, the teeth 1–1.7 mm. long, *petals* whitish or cream-colored, sometimes lilac-tinged; *banner* 9–12.8 mm. long, 6.5–8.8 mm. wide; *wings* (0.7–2 mm. shorter) 7.8–11 mm. long, the claws 3.1–5 mm., the blades (5) 5.4–8.9 mm. long, (2) 2.2–3.2 mm. wide; *keel* (± equaling the wings) 7.5–11.2 mm. long, the claws 3.5–5 mm., the blades 4.2–6.5 mm. long, 2.3–3 mm. wide; *pod* loosely and sparsely strigulose, the stipe 2.5–5.5 (6) mm. long, the body (1.5) 2–4 (5.5) cm. long, (0.8) 1–2.2 (or, when pressed, up to 2.6) cm. wide; *ovules* 21–27.—Collections: 34 (o); representative: *J. W. Thompson 10,539* (NY, WS, WTU), *14,758* (NY, SMU, WS, WTU); *Kruckeberg 2513* (CAS, ID, NY, WS); *Pickett 1537* (WS, WTU); *Cronquist 7348* (CAS, ID, NY, RSA), *7417* (NY, RSA); *Maguire & Holmgren 26,774* (NY, RSA, UTC).

Open rocky crests and summits near timber line, descending to well-drained gravelly flats and hillsides in the timber belt, on volcanic or metamorphic bedrock, especially abundant on serpentine, locally plentiful in scattered stations in interior Washington, Oregon, and westcentral Idaho: Wenatchee, and east slope of the Cascade ranges in Chelan, Kittitas, and Yakima Counties; Blue and Wallowa Mountains of southeastern Washington and northeastern Oregon; mountains of central transmontane Oregon in southern Gilliam, Morrow, eastern Grant, southern Wheeler, and northern Crook Counties; Steens Mountains, Harney County; Valley County (near Cascade), Idaho.—Map No. 32.—June to August.

ASTRAGALUS WHITNEYI var. SONNEANUS (Greene) Jeps., Fl. Calif. 2: 347. 1936, based on *A. Sonneanus* (Charles Frederick Sonne, 1845–1913, active in the n. Sierra Nevada in late XXIX century) Greene, Pittonia 3: 186. 1897, a legitimate substitute for *A. Hookerianus* (T.

& G.) Gray in Proc. Amer. Acad. 6: 215. 1864 (non D. Dietr., 1850), based on *Phaca Hookeriana* (William Jackson Hooker, 1785–1865) T. & G., Fl. N. Amer. 1: 693. 1840.—"Interior of Oregon, probably near the Rocky Mountains, Douglas."—Holotypus, lacking locality-data but probably collected in the Blue Mountains, Columbia or Garfield County, Washington, GH! isotypi, BM (dated "1835"), NY, OXF (dated "1830")!—*Tragacantha Hookeriana* (T. & G.) O. Kze., Rev. Gen. 945. 1891. *Astragalus Whitneyi* subsp. *Hookerianus* (T. & G.) Abrams, Ill. Fl. Pac. St. 2: 583. 1944.

Torrey and Gray's dedication of the northern balloon milk-vetch to the revered Sir William Hooker is an indication of how remarkable the species must have appeared at the time of its discovery. It remains a striking plant, even though it has come to bear, through accidents of duplication and misinterpretation (implicit in the synonymy, but cf. further Barneby, 1950, p. 206), the epithet *Sonneanus* intended in the first place to apply to the Sierran var. *lenophyllus*. The brightly mottled pod was originally described as "nearly two inches long," but only exceptionally reaches a length of 5 cm., and fruits 2–4 cm. long are commonest. The variety is easily recognized by its short racemes of small flowers, slender, decumbent stems, and ovary and pod at least thinly strigulose. The herbage varies from ashen to green in hue, and the petals, described by one collector in the Wenatchee Mountains as ochroleucous, are, at least sometimes in central Oregon, tinged with dull purple. Like var. *siskiyouensis* the northern balloon milk-vetch is especially abundant on outcroppings of metamorphic or serpentine bedrock, although not confined to such formations.

87e. Astragalus Whitneyi var. confusus

Relatively robust but sometimes low, the decumbent, ascending, or erect stems 1–3 (sometimes in flower when only 0.5) dm. long, the herbage gray- or silvery-villosulous with shorter, curly or sinuous, and longer, straight or incurved-ascending hairs up to 0.45–0.8 mm. long; *leaves* (2) 3–10 cm. long, with (7) 13–21 elliptic or oblanceolate, or (in some lower leaves) obovate, obtuse, acute, or emarginate leaflets (3) 5–20 mm. long; *racemes* (5) 8–16-flowered, the axis (1) 1.5–4 cm. long in fruit; *calyx* (5.8) 6.1–9.3 mm. long, the tube (4) 4.6–5.9 mm. long, (3) 3.4–4.6 mm. in diameter, the teeth (1.5) 1.8–3.6 mm. long; *petals* whitish tinged with pale pink or lavender, sometimes drying ochroleucous; *banner* (12.8) 13.5–17.2 mm. long, 7.2–10.2 mm. wide; *wings* (12.1) 12.6–15.4 mm. long, the claws (5) 5.4–6.5 mm., the blades (7.3) 8–10 mm. long, 2.8–4 mm. wide; *keel* (11.2) 11.8–13.8 mm. long, the claws 5–6.4 mm., the blades (6.3) 6.8–8.1 mm. long, (2.8) 3–3.8 mm. wide; *stipe* of the *pod* 4–9 mm. long, the *body* (1.7) 2–6 cm. long, (1) 1.3–2.5 (when pressed up to 2.8) cm. in diameter, the valves strigulose; *ovules* 22–30 (37).—Collections: 31 (ii): representative: *J. W. Thompson 13,207* (NY, WTU); *Maguire & Holmgren 26,636* (CAS, NY, RSA, UTC, WS); *E. K. Balls 14,741, 15,964* (CAS, RSA); *Alexander & Kellogg 5043* (TEX, WS); *Nelson & Macbride 2067* (ID, NY, RM, WTU).

Open slopes and hillsides, in sandy or gravelly, basaltic or sometimes granitic soils, usually associated with and often sheltering under sagebrush, 4400–8000 (8900) feet, locally plentiful in the lake country of northeastern California and adjoining Oregon, east (perhaps interruptedly) to the Owyhee-Humboldt divide in northeastern Nevada and southeastern Idaho; somewhat disjunctly on the south slope and crest of the Sawtooth Mountains in southcentral Idaho.—Map No. 32.—April to July.

Astragalus Whitneyi var. confusus (confused with var. *Sonneanus*) Barneby in El Aliso 2: 206. 1950.—"California: . . . northwest of Alturas, Modoc County . . . 31 May 1944, *Ripley & Barneby 5992*."—Holotypus, CAS! isotypus, RSA!

The var. *confusus* can be visualized as a coarser, large-flowered version of the preceding, on the average more densely and loosely pubescent. It occupies a more southern range, mostly at lower elevations, characteristically associated with sagebrush. It is especially common in Modoc County, California, and adjoining Lake County, Oregon, and again in Owyhee County, Idaho; but I have no intervening record from Harney or Malheur Counties. The variety reappears on the north rim of the Snake River Plains in a narrow strip of foothill country

extending from the Craters of the Moon to Sun Valley, where it reaches almost up to the 9000-foot contour near Galena Summit. In this area the pod is sometimes nearly glabrous, but the ovary is always hairy. In northeast California, along Pit River and near Susanville in southwestern Modoc and Lassen Counties, there occurs a balloon milk-vetch which combines the vigorous stature and large, pinkish flowers of var. *confusus* with the thinner vesture and open raceme often associated in var. *siskiyouensis*. These populations, in some of which the pod varies from glabrous to puberulent from one plant to the next (*Ripley & Barneby 5747*, CAS, NY, RSA), have been referred to var. *confusus* on the basis of their ecology and distribution, but they are morphologically intergradient to var. *siskiyouensis*.

XIX (iii). Subsectio Picti

Root-crown subterranean, usually deeply buried, the stems of the year arising below ground singly or few together from slender, widely divergent caudex-branches or from horizontally creeping rhizomes; *vesture* basifixed or dolabriform; *leaflets* of some or all leaves commonly small, few, or upwardly wanting, the terminal one continuous with the rachis; *pod* stipitate or (*A. ceramicus* var. *apus*) sessile, ± bladdery-inflated, the papery or papery-membranous valves mottled.—Spp. 2, xerophytes, 1 polymorphic and widely dispersed over the Great Plains from South Dakota to western Oklahoma, west to southeastern Idaho, Utah, and northern Arizona, 1 very rare and local in extreme southwestern Idaho and adjoining Oregon.

Astragalus sect. Cusickiani subsect. Picti (Jones), comb. nov., based on *Astragalus* sect. *Inflati* subsect. *Picti* Jones, Rev. Astrag. 94, in clave. 1923.—Sp. typica: *A. pictus* Gray = *A. ceramicus* Sheld.—*Phaca* subgen. *Podocystis* sect. *Pictae* Rydb. in N. Amer. Fl. 24: 341. 1929.

Physondra Raf., Atl. Jour. 1[4]: 145. 1832.—Generitypus: *P. longifolia* (Pursh) Raf. = *A. ceramicus* var. *filifolius* (Gray) F. J. Hermann, the only sp. agreeing with the generic character "pod stipitate, swelled, membranaceous."

The two species of subsect. *Picti* are set off by themselves on account of the modified growth-habit which is correlated with adaptation to specialized types of habitat. The very local *A. sterilis* is found at the southern periphery of the range of *A. Cusickii* of the last subsection and may be derived from it; the two species have almost identical flowers and fruits. The second member of the subsection, *A. ceramicus*, in some forms of which the hairs have assumed a suprabasal attachment, is more isolated morphologically and may possibly have arisen by parallel evolution from some other homaloboid source.

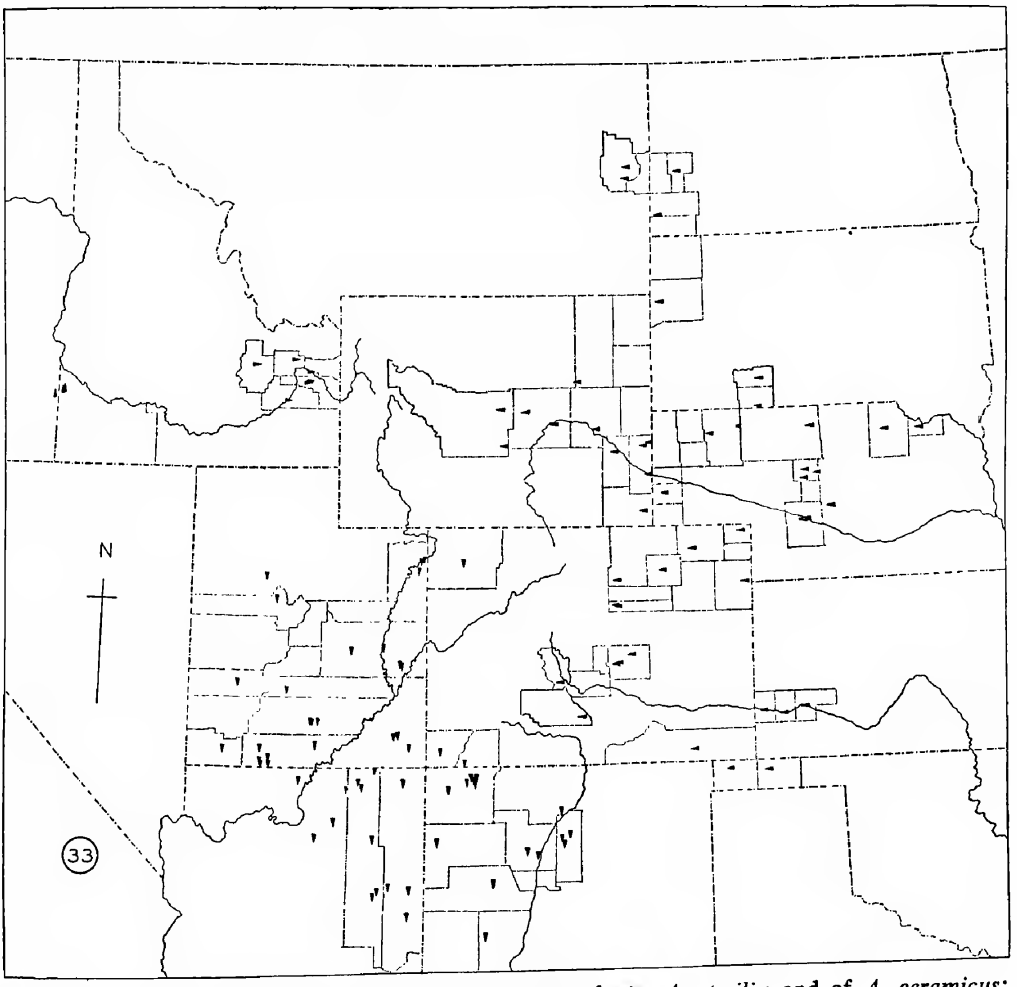
Key to the Species of Subsect. Picti

1. Lower stipules or stipule-sheaths longer than the tiny upper ones; *calyx-teeth* 0.4–0.6 mm. long; *stems* freely branched on emergence, the branches divaricate and incurved, forming low, wiry entanglements of stems and leaves spaced at intervals of 2–10 cm. along horizontal rhizomes; w. Owyhee County, Idaho, and immediately adjoining Malheur County, Oregon ..... 88. *A. sterilis*
1. Lower stipules smallest; *calyx-teeth* 1–3 mm. long; *stems* simple or few-branched above ground, terminating very slender, rhizome-like caudex-branches traceable back to the deeply buried crown of the taproot; s.-e. Idaho e.- and s.-ward. ..... 89. *A. ceramicus*

88. Astragalus sterilis

Dwarf, sparsely leafy, wiry, somewhat junceous, strigulose nearly throughout with straight, appressed or narrowly ascending hairs up to 0.35–0.5 mm. long, pale green or subcinereous; *stems* 6–16 cm. long, slender, simple, subterranean for a space of 2–8 cm., at emergence stouter and immediately branching, the short emersed internodes abruptly zigzag, each stem or small group of stems forming low entangled tufts; *stipules* 1.5–4 (5) mm. long, the buried and lowest aerial pairs papery-membranous, connate into a campanulate, bidentate sheath, the median and upper ones progressively smaller and more shortly connate or almost free, with deltoid or triangular-acuminate, mostly deflexed, herbaceous blades; *leaves* 2–9 cm. long, shortly petioled, with stiff rachis and 6–10 distant, often scattered, linear-

elliptic, obtuse, involute, obscurely jointed leaflets 1–5 mm. long, the terminal one represented by a slight dilation of the rachis; *peduncles* slender, erect and incurved-ascending, (1) 2–7 cm. long; *racemes* very loosely (1) 2–5-flowered, the flowers early spreading, then declined, the axis (0) 1–6 cm. long in fruit; *bracts* membranous, ovate or subulate, 0.7–1.3 mm. long; *pedicels* at anthesis straight, ascending, 1–1.3 mm. long, in fruit arcuate-recurved, 1.5–2 mm. long; *bracteoles* 0; *calyx* 3.5–4 mm. long, thinly strigulose with white and a few black hairs, the subsymmetric disc 0.6–0.8 mm. deep, the pallidly submembranous tube 3–3.6 mm. long, 2.2–2.5 mm. in diameter, the deltoid or triangular-subulate, herbaceous teeth 0.4–0.6 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous fading yellowish, concolorous; *banner* abruptly recurved through ± 85°, suborbicular-cuneate, shallowly notched, 9–10 mm. long, 6.5–8 mm. wide; *wings* 7.5–9.2 mm. long, the claws 3.5–4.5 mm., the oblong, obtuse, slightly incurved blades 5–5.4 mm. long, 1.8–2.2 mm. wide; *keel* 8–9 mm. long, the claws 3.7–4.2 mm., the broadly lunate blades 4.8–5 mm. long, 2.5–3 mm. wide, abruptly incurved through 85–95° to the triangular, sometimes subporrect, obtuse but beaklike apex; *anthers* 0.5–0.55 mm. long; *pod* pendulous, stipitate, the straight, slender stipe ± 3 mm. long, the obliquely obovoid body bladdery-inflated,



Map No. 33. Parts of western United States. Range of ◢◣ *A. sterilis*; and of *A. ceramicus*: ◥◤ var. *ceramicus*; ◖ var. *filifolius*; and ◗ var. *apus*.

2–2.5 cm. long, 9–11 (when pressed up to 14) mm. in diameter, cuneately tapering at base into the stipe, abruptly contracted distally into a short and obscure, laterally compressed beak, otherwise a trifle dorsiventrally compressed, shallowly and openly sulcate ventrally, the filiform sutures both convexly arched but the dorsal one a little more strongly so, the papery-membranous, diaphanous, finely reticulate, glabrous valves purple-mottled on a pale green at length stramineous and lustrous ground, not inflexed; *ovules* 17–20; *seeds* (not quite ripe) ± 2–2.5 mm. long.—Collections: 3 (ii); representative: *Ripley & Barneby 6149* (K, RSA); *Peck 20,620* (WILLU, in bud only).

Dry gravelly and sandy clay bluffs and knolls almost bare of other vegetation, in soils of basaltic origin, 4200–4300 feet, rare and local, known only from upper Sucker Creek in northwestern Owyhee County, Idaho, and from bluffs along the Owyhee River in adjoining Malheur County, Oregon.—Map No. 33.—June and July.

ASTRAGALUS STERILIS (barren) Barneby in Leafl. West. Bot. 5: 193. 1949.—"IDAHO: ... 24 miles southwest of Marsing, Owyhee County, alt. 4300 ft., 26 June, 1948, fl. & fr., *Ripley & Barneby 9415*."—Holotypus, CAS! isotypi, GH, IDS, NY, POM, RSA, US, UTC, WILLU.

The barren milk-vetch, so called because of its shyness in bearing flowers and fruits even in favorable seasons, was first taken for a starveling form of *A. Cusickii*, but the root-system of the two species is so different that there can be no doubt we are dealing with two perfectly discrete entities. The main range of *A. Cusickii* lies farther north in the canyons of the Snake River, but it has been traced south to a point on Sucker Creek only a few miles distant from the small area near Rockville to which *A. sterilis* is apparently endemic. It seems possible that the latter arose as a favored mutation from *A. Cusickii* which developed a subterranean, eventually rhizome-like caudex and coincidentally became adapted to the specialized environment of open clay knolls or hilltops. The flowers and pods of the two species are closely similar, but *A. sterilis* is recognized at sight by its low, freely branching growth and few-flowered racemes.

89. ASTRAGALUS CERAMICUS

Slender, wiry, of distinctive aspect, with root-crown deeply buried except when accidentally brought near the surface or even exposed by shifting of mobile dunes, densely strigulose with fine, straight, appressed or narrowly ascending, basifixed or dolabriform hairs up to (0.2) 0.3–1.1 mm. long, the stems and sparse herbage ashen or silvery-canescent; *stems* few, in most collected specimens appearing solitary, arising directly from the root-crown in young plants, or subsequently from simple or sparingly branched, very slender, widely creeping rhizome-like caudex-branches, subterranean for a space of 3–40 cm. where the distant nodes are marked by short, scarious stipule-sheaths and sometimes by filiform adventitious roots, the aerial part decumbent or ascending, 3–30 (40) cm. long, simple or divaricately few-branched on emergence, commonly zigzag distally; *stipules* 1.5–9 mm. long, somewhat dimorphic, those at the first exposed nodes connate into a brown, firmly chartaceous, or pallid, subscarious, truncate or bidentate sheath, the longer upper ones herbaceous, connate through half their length or at base only, with deltoid-acuminate or lanceolate, erect, spreading, or rarely deflexed blades; *leaves* 2–17 cm. long, with slender petiole and rachis, the lowest (commonly) or sometimes all bearing 1–6 pairs of usually distant, shortly petiolulate, filiform or linear-oblong, obtuse or acute, more rarely narrowly oblong and retuse, mostly involute lateral leaflets 3–30 mm. long, the terminal leaflet similar to the rest but continuous with the rachis, or drawn out into an elongated, linear-oblanceolate or filiform blade much longer than the uppermost pair, or the upper leaves, or sometimes all, reduced to a linear-filiform phyllode devoid of lateral leaflets; *peduncles* divaricate and incurved, (0.7) 1.5–7.5 cm. long; *racemes* loosely 2–15 (in rare

robust individuals up to 25)-flowered, the flowers at first ascending, ultimately spreading and declined, the axis 1–8 (15) cm. long in fruit; *bracts* submembranous, ovate or lanceolate, (0.6) 1–2.2 (2.5) mm. long; *pedicels* at anthesis slender, ascending, 0.7–2.5 mm. long, in fruit spreading or arched outward, commonly twisted, scarcely thickened, 1.2–3.1 mm. long; *bracteoles* commonly 0, minute when present; *calyx* 3.1–6 mm. long, strigulose like the herbage with white and often some shorter black hairs, the subsymmetric disc 0.5–1 mm. deep, the campanulate tube 2.1–3.5 mm. long, 1.6–3 mm. in diameter, the subulate teeth 1–3 mm. long, the whole becoming papery, marcescent, usually unruptured; *petals* whitish or flesh-pink, sometimes veined or suffused with lavender, rarely dull purple throughout; *banner* abruptly recurved through ± 90°, 6.3–10.8 mm. long, the broadly cuneate-flabellate claw expanded into a broadly obovate, suborbicular, or reniform, shallowly notched blade 6–8.5 mm. wide; *wings* 6–10.6 mm. long, the blades obliquely obovate, obtuse or shallowly emarginate; *keel* 6.4–9.1 mm. long, the blades lunately half-elliptic, incurved through 65–85 (95)° into a narrowly triangular, subacute, sometimes porrect apex; *anthers* 0.45–0.65 mm. long; *pod* pendulous, stipitate or rarely sessile, the stipe up to 3.3 mm. long, the body subsymmetrically ellipsoid, ovoid, or subglobose, bladdery-inflated, (1.2) 1.5–5 cm. long, (5) 6–26 mm. in diameter, cuneate or rounded at either or both ends, shortly cuspidate or obscurely conic-beaked at apex, subterete or (when greatly inflated) shallowly and openly sulcate ventrally, the sutures both filiform and subequally convex, the thin, glabrous, brightly red- or purple-mottled valves becoming papery, reticulate, ultimately purplish-brown, lustrous, not inflexed, the funicular flange obsolete or up to 0.4 mm. wide; *ovules* 12–29; *seeds* brown, nearly smooth or minutely pitted, dull, (2.1) 2.4–3.1 mm. long.

In all its varied forms the painted milk-vetch, *A. ceramicus,* retains its marked individual facies and is almost never misidentified. Except for *A. sterilis,* no other astragalus combines a diffusely cryptophytic growth-habit with decurrent terminal leaflets and inflated pod. Because of the sparseness of the foliage and the small size of the pinkish or dingily purple-tinged flowers, the plants make no great show until the beautifully red-mottled balloons or fusiform bladders of the fruit are well advanced. In ordinary circumstances at least half and often more than half the year's growth remains concealed in sand. Care is therefore required to trace the very slender stems or caudex-branches back to their common source at the crown of the vertical or oblique rootstock, for this is often buried far distant from the point of emergence of the apparently solitary stems. Few herbarium specimens possess more than vestiges of the subterranean parts, and still fewer show the occurrence, although this is by no means rare, of adventitious rootlets issuing here and there from buried nodes. Whether these rootlets often grow on to assume the function of an independent taproot (as happens in *A. pictiformis* of sect. *Scytocarpi*) and thus perpetuate the parent plant by clonal reproduction has not been established, although I have seen two examples of this.

The painted milk-vetch is everywhere confined to dunes or to regions where loose sandy soils predominate, and although it is widely dispersed over the arid western United States and locally abundant, it is not really common. Distance between colonies, with consequently reduced opportunities for exchange of pollen, seems to have encouraged the perpetuation of small regional differences, and the species consists of many minor races. The material can readily be sorted, however, into two principal categories corresponding more or less precisely with *Phaca longifolia* and *P. picta* as defined by Rydberg (1929, pp. 341–2). The latter, our *A. ceramicus* var. *ceramicus,* which is dispersed from the upper Rio Grande Valley northwest across the Colorado Plateau to central and southwest Utah, is distinguished by the dolabriform attachment of many or all hairs on leaf and stem. In *P. longifolia,* our var. *filifolius,* the hairs are all basifixed or nearly so (cf. Kearney, sub *A. mitophyllo,* l.c.) and its range extends across the prairie province from northwestern Oklahoma to North Dakota and eastern Montana, west only to the Atlantic slope of the Rocky Mountains. The eastern branch of the species tends to have larger flowers and pods and fewer lateral leaflets, and the ovules are almost consistently more numerous than in var. *ceramicus.* There remains, however, much variation in size of the flowers and pods not correlated with development of the leaflets, with hair-attachment, or with ovule-number. The typus of var. *magnus* Jones represents one of

those forms of var. *ceramicus* which mimic var. *filifolius* in the greatly swollen fruit but retain the vesture and ovule-number of the western variety. The typus of var. *angustus* Jones consists of one almost leafless plant and another with well-developed lateral leaflets, a common type of variation within colonies of otherwise like plants on the Colorado Plateau. Some populations in the Uinta Basin, referred to var. *ceramicus* on the basis of their dolabriform vesture and small flowers, closely simulate var. *filifolius* in their large, pluriovulate fruits and almost complete absence of lateral leaflets. High on the east slope of the Colorado Rocky Mountains, along the upper Arkansas River and in San Luis Valley at elevations near 8000 feet, there exists a form of the painted milk-vetch embodying the small pod and well-developed leaflets ordinary in var. *ceramicus* with the many ovules of var. *filifolius*, of which it is interpreted as a high-altitude variant. Enough has been said to show that an effective key to the main divisions of the species is not easily devised. In practice the type of pubescence and the ovule-number have proved more reliable as diagnostic characters than the more easily observed features of the foliage and size of pod.

The foregoing remarks apply only to the forms of *A. ceramicus* with stipitate fruits. In southeast Idaho, about the great north bend of the Snake River, there is a large area of dunes and wind-blown sands remote from the main range of the species, and this is occupied by a form quite similar to var. *filifolius* in every detail except that the pod is sessile. It is described below as var. *apus*.

Key to the Varieties of A. ceramicus

1. Pod stipitate, the stipe (1) 1.5–3.3 mm. long; widespread, but not in Idaho (2)
   2. Vesture of the stems and herbage composed entirely or very largely of dolabriform hairs; *calyx* mostly 3.1–4.2 mm., rarely up to 5.7 mm. long; *body* of the pod (1) 1.5–3 cm. long, 5–15 mm. in diameter; *ovules* 12–16, rarely (in the Uinta Basin) up to 23; n.-w. New Mexico to Utah, n. Arizona, and w. Colorado ..... 89c. var. *ceramicus*
   2. Vesture composed entirely of basifixed hairs (rarely a few minutely spurred at base); *calyx* mostly 4–6 mm. long; *body* of the pod (2) 3–5 cm. long, 1.4–2.6 cm. in diameter; *ovules* (17) 20–29; Great Plains and e. slope of the Rocky Mountains, North Dakota and e. Montana to Colorado and w. Oklahoma ..... 89a. var. *filifolius*
1. Pod sessile or nearly so; s.-e. Idaho ..... 89b. var. *apus*

89a. Astragalus ceramicus var. filifolius

Leaves 2.5–17 cm. long, commonly all reduced to the filiform rachis, only some lower leaves with 1–2 (3) pairs of lateral leaflets; *racemes* 2–7-flowered, the axis 1–4.5 (5.5) cm. long in fruit; *calyx* (3.7) 4–6 mm., the tube (2.3) 2.5–3.5 mm. long, 2.5–3 mm. in diameter, the teeth (1.4) 1.6–3 mm. long; *banner* 7.4–10.8 mm. long, 6.2–8.5 mm. wide; *wings* 6.9–10.6 mm. long, the claws 2.4–3.4 mm., the blades 4.6–8.2 mm. long, 2.3–4 mm. wide; *keel* 7–9.1 mm. long, the claws 2.5–3.4 mm., the blades 4.5–6.1 mm. long, 2.2–2.8 mm. wide; *stipe* of the pod 1.5–3 mm. long.—Collections: 49 (ii); representative: *L. Moyer 479* (NY); *C. L. Porter 5722* (NY, RM, SMU, TEX); *Goodding 277* (MO, NY, RM); *Ripley & Barneby 9083* (CAS, RSA, UTC); *Clokey, Schmoll & Bethel 4191* (CAS, WIS, WS); *Brandegee 925* (NY); *G. W. Stevens 407* (NY).

Dunes and sandy hollows in rolling plains, sometimes in sandy fields or on sand bars of intermittent streams, mostly below 7000 feet, locally plentiful in scattered stations over the higher Great Plains from western North Dakota and eastern Montana south through eastern Wyoming and Nebraska to the Arkansas Valley in Colorado and western Kansas, and south just into the Oklahoma Panhandle; in Colorado extending west up the Arkansas into Chaffee County and to San Luis Valley in Saguache County, there reaching 8300 feet.—Map No. 33.—Late April to July.

Astragalus ceramicus var. filifolius (Gray) F. J. Hermann in Jour. Wash. Acad. 38: 237. 1948, based on *A. pictus* var. *filifolius* (Gray) Gray in Proc. Amer. Acad. 6: 215. 1864, based in turn on *A. filifolius* (with threadlike leaves) Gray in Pac. R.R. Rep. 12: 42, Pl. I. 1859 (non *A. filifolius* Clos, 1846), based in turn on *Psoralea longifolia* Pursh, Fl. Amer. Sept. 741. 1814.—"Upper Louisiana, Bradbury."—Holotypus, labeled "Pursh's specimen," PH!

isotypus, NY (fragm. ex herb. Lambert.)!—*Orobus longifolius* (Pursh) Nutt., Gen. 2: 95. 1818. *Physondra longifolia* (Pursh) Raf., Atl. Jour. 1[4]: 145. 1832. *Phaca longifolia* (Pursh) Nutt. ex T. & G., Fl. N. Amer. 1: 136. 1838. *Astragalus ceramicus* var. *imperfectus* (incomplete, of the leaves) Sheld. in Minn. Bot. Stud. 1: 19. 1894 (Jan.), an improper substitute of epithet. *A. ceramicus* var. *longifolius* (Pursh) Rydb. in Bot. Surv. Neb. 3: 31. 1894 (June) & in Contrib. U. S. Nat. Herb. 3: 154. 1895 (Sept.). *A. angustus* var. *longifolius* (Pursh) Jones in Proc. Calif. Acad. Sci. II, 5: 635. 1895 (Oct.). *A. longifolius* (Pursh) Rydb., Fl. Neb. 21: 47, Pl. XI, fig. 79–81. 1895 (Dec.), corrected in Errata to *A. ceramicus* var. *longifolius*. *A. filifolius* (Gray) Smyth in Trans. Kans. Acad. 15: 61. 1895 (non Clos, 1846). *A. angustus* var. *imperfectus* (Sheld.) Jones, Contrib. West. Bot. 10: 62. 1902. *A. longifolius* (Pursh) Gates in Trans. Kans. Acad. 42: 137. 1940 (non Lamk., 1853). *A. mitophyllus* (thread-leaved) Kearney in Leafl. West. Bot. 4: 216. 1945, a legitimate substitute.

The var. *filifolius* is especially common on the sandhills of western Nebraska. The pod in this region is very large, up to 5 cm. long and proportionately swollen; elsewhere pods over 4 cm. long are rarely met with, but in other respects the plants of the prairie states do not vary greatly. All leaves, except a few of the lowest, are reduced to the unadorned rachis which may be truly filiform or a little dilated distally in the form of a linear leaflet. Thus the general aspect of the average plant is leafless and broomlike; the stems are weak and pliant, offering little resistance to the wind. Mention has been made already of a relatively leafy variant with pods of moderate size found on the east slope of the Rocky Mountains in southern Colorado at elevations near 8000 feet. This form, known from only three localities (Crestone, Saguache County, *Ramaley & Johnson 14,836,* NY; Buena Vista and Salida, Chaffee County, *Ripley & Barneby 10,350,* RSA & *Clements 114,* NY), deserves further study.

Few species, I suppose, have accumulated a more massive synonymy of the purely nomenclatural sort. All fifteen binomial and trinomial combinations listed above are based ultimately on *Psoralea longifolia* Pursh. At the time of its discovery the painted milk-vetch was an altogether unprecedented type of papilionaceous legume, and early transfers to *Orobus* and the specially created *Physondra* recall that fact. When compared subsequently with several of Nuttall's leafless *Homalobi,* its affinity to *Phaca* and *Astragalus* became apparent, although it still differed from genuine *Homalobus* in its inflated fruit. Names proposed since 1864, when Gray consolidated these genera into *Astragalus* sens. lat., reflect the search for epithets acceptable in their category under rules of nomenclature which have shifted as often as the very sands in which the species grows.

89b. Astragalus ceramicus var. apus

Wholly similar to var. *filifolius* except for the sessile pod; *lateral leaflets* wanting or nearly so; *pod* 2–4 cm. long, ± 1.5–2.4 cm. in diameter.—Collections: 6 (ii); representative: *C. L. Hitchcock 15,762* (NY, RSA, UTC, WS); *Merrill & Wilcox 787* (NY, US); *Ripley & Barneby 8874* (RSA), *8883* (IDS, RSA).

Dunes and sandy flats, ± 4400–4800 feet, apparently not uncommon about the east end of the Snake River Plains, from near the sinks of the Lost Rivers in Butte County, east to western Madison and northwestern Bonneville Counties, Idaho.—Map No. 33.—May to July.

Astragalus ceramicus var. apus (footless, of the sessile pod), var. nov., leguminibus stipite obsoleto arcte sessilibus ab aliis omnibus speciei formis insuper procul allopatricis diversa—Omnia caetera var. *filifolii* (Gray) F. J. Hermann.—Idaho: Idaho Falls, Bonneville County, in 1893, *Edward Palmer 348.*—Holotypus, WIS! isotypus, US!

In its basifixed pubescence, almost complete lack of lateral leaflets, flowers of moderate size, and in number of ovules, the painted milk-vetch of the Snake River Plains closely matches some forms of *A. ceramicus* var. *filifolius* from east of the Rocky Mountains, but it apparently differs consistently in the sessile pod. The known range of var. *apus* extends over an area about sixty miles in diameter and lies distant two hundred miles west from the last outpost of var. *filifolius* on the upper Platte and Big Horn Rivers in Wyoming. The variety was first collected near Fort Hall, in 1845 or 1846, by Joseph Burke (K).

89c. Astragalus ceramicus var. ceramicus

Leaves 2–12 (15) cm. long, at least the lowest and sometimes all bearing 1–6 pairs of lateral leaflets, but the uppermost ones quite often reduced to the naked rachis; *racemes* 6–15 (25)-flowered, the axis (1) 1.5–8 (15) cm. long in

fruit; *calyx* 3.1–4.2 (5.7) mm. long the tube 2.1–2.6 (3.3) mm., the teeth 1–1.8 (2.4) mm. long; *banner* 6.3–8.3 (9.5) mm. long, 6–7.5 (9) mm. wide; *wings* 6–7.7 (8.3) mm. long, the claws 2–3 mm., the blades 4.3–5.6 (6) mm. long, 2.1–3.2 (3.7) mm. wide; *keel* 6.4–7.6 (8.4) mm. long, the claws 2.1–3.2 mm., the blades 4.2–5 (6) mm. long, 2–2.5 (2.8) mm. wide; *stipe* of the pod (1) 1.5–3.3 mm. long, the body ellipsoid, ovoid, or subglobose, (1.2) 1.5–3 cm. long, (5) 6–15 mm. in diameter; *seeds* (2.1) 2.4–3.1 mm. long.—Collections: 60 (xiv); representative: *Holmgren & Hansen 3434* (NY, UTC); *Peebles & Smith 13,899* (CAS, NY); *J. T. Howell 24,433, 24,522* (CAS, RSA); *A. & G. Heller 3572* (ND, OB, WS); *Ripley & Barneby 5288* (CAS, RSA), *5303* (NY, RSA).

Mobile dunes, sandy plains, sand pockets and gullied talus at the foot of cliffs, sandy badlands, rarely on cinder cones, characteristically associated with red and white sandstones, 4600–7000 feet, widespread and rather common in the Colorado Basin southward from the Uintah Mountains, Utah, northern Arizona, and southwestern Colorado, extending southeast across the Continental Divide from the San Juan River to the upper Rio Grande in northwestern New Mexico; occasionally west of the Wahsatch Plateau in westcentral, northcentral, and southwestern Utah.—Map No. 33.—Late April to July.

ASTRAGALUS CERAMICUS (of pottery, from the painted pod) Sheld. in Minn. Bot. Stud. 1: 19. 1894, a legitimate substitute for *A. pictus* (Gray) Gray in Proc. Amer. Acad. 6: 214. 1864 (non Bss. & Gaill., 1859), based on *Phaca picta* (painted, of the mottled pod) Gray in Mem. Amer. Acad. II, 4 (Pl. Fendl.): 37. 1849.—"... on the banks of the Rio del Norte... April (in flower) and June (in fruit), No. 161."—Holotypus, *Pl. Novo-Mexicanae 161,* collected by August Fendler in 1847, GH! isotypi, BM, K, MO (dated "May"), NY, OXF, P, PH!—*A. pictus* var. *foliolosus* (bearing leaflets) Gray in Proc. Amer. Acad. 6: 215. 1864, an exact synonym designating *Phaca picta* sens. str. *Tragacantha picta* (Gray) O. Kze., Rev. Gen. 947. 1891 *("pictus"). A. foliolosus* (Gray) Sheld. in Minn. Bot. Stud. 1: 138. 1894 (non Bunge, 1869). *A. angustus* var. *pictus* (Gray) Jones in Proc. Calif. Acad. Sci. II, 5: 635. 1895. *A. angustus* var. *ceramicus* (Sheld.) Jones, Contrib. West. Bot. 10: 62. 1902.

Astragalus pictus var. *angustus* (narrow, of the pod) Jones in Zoë 4: 37. 1893.—"Montezuma Canon, Utah, May, 1892, Miss Alice Eastwood."—Holotypus, *Eastwood 7,* POM! isotypus, US!—*A. ceramicus* var. *Jonesii* (Marcus Eugene Jones) Sheld. in Minn. Bot. Stud. 1: 19. 1894, a superfluous, illegitimate substitute for var. *angustus,* misread as *"angustatus"* and supposedly antedated by *A. angustatus* Bss. *A. angustus* (Jones) Jones in Proc. Calif. Acad. Sci. II, 5: 635. 1895.

Astragalus pictus var. *magnus* (large, of the swollen pod) Jones, Rev. Astrag. 109, Pl. 12. 1923.—"My specimens No. 5160 from Silver Reef Utah constitute the type."—Holotypus, collected May 3, 1894, POM! isotypi, MO (dated "May 6"), NY, P, RM!

The nomenclaturally typical form of *A. ceramicus* has comparatively short and little-swollen pods combined with developed lateral leaflets in all or in most leaves. The populations known from the upper Rio Grande Valley are of this sort, but an ellipsoid pod of the same type is found here and there across northern Arizona and southern Utah, associated either with many pinnate leaves or with simple phyllodes. Leaves of both sorts may sometimes be found in the same locality (e.g., the holotypus of var. *angustus*), although this has been seldom observed. Jones described var. *magnus* upon discovering that his var. *angustus* was equivalent to the original *Phaca picta;* it was intended to cover the same ground as var. *filifolius* Gray. In the strict sense, however, var. *magnus* is the minor variant of var. *ceramicus* characterized by an ovoid or globose fruit and many dolabriform hairs. It is as common as the *angustus* variant in northern Arizona but extends to the limits of the variety in western Utah. Pods of the greatly inflated type may also be associated with either simple or pinnate foliage, and the forms with many phyllodes closely simulate var. *filifolius* from the prairie states. The few populations known from the Uinta Basin in extreme northeastern Utah and adjoining Colorado have the greatly swollen pod and high ovule-number ($\pm$ 23) of genuine var. *filifolius* but have been referred to var. *ceramicus* because of the dolabriform vesture.

XX. Sectio ERVOIDEI

Caulescent perennials, with superficial root-crown or caudex, the stems comparatively simple and then either erect or diffuse, or repeatedly branched and then

matted or rarely pulvinate; *vesture* basifixed or (in some vars. of *A. Kentrophyta*) dolabriform; *stipules* all, or at least those low on the stems, connate; *leaves* imparipinnate, with 3–21 (25) leaflets, these either decurrent or jointed; *racemes* loosely or remotely 1–20 (23)-flowered, the flowers small, early or ultimately declined or deflexed, the banner 4–10.5 mm. long; *pedicels* slender, little or not thickened in age, either persistent or tardily deciduous; *calyx-tube* campanulate or turbinate-campanulate; *petals* regularly graduated, the banner recurved through 40–90°, the keel-tip obtuse; *pod* declined or pendulous, sessile or stipitate, persistent or deciduous from the receptacle, the body varying from linear-oblong or ovate-lenticular in profile and then strongly compressed and bicarinate by the sutures, in subsect. *Microcystei* plumply ovoid- or obovoid-subglobose and bladdery-inflated, the valves papery, not inflexed; *ovules* 2–8 (11).—Spp. 5, xerophytes, widely dispersed through the Rocky Mountains and intermountain states from New Mexico to Yukon, west to eastern California, east to Hudson Bay, Minnesota, and Nebraska.

The section *Ervoidei* is composed of three subsections approximately equivalent to Rydberg's *Homalobus* sect. *Tenelli,* his genus *Kentrophyta,* and *A. microcystis,* which was referred to *Phaca* on account of its inflated pod. The apparently heterogeneous components of the section are in reality very closely interrelated, for the taxonomic importance of the technical characters, particularly of the pod, upon which Rydberg's segregate genera were principally based, has been exaggerated greatly. The species crucial to an understanding of the *Ervoidei,* the one around which the section gathers itself together by means of accretion from three directions, is *A. vexilliflexus.* The tallest and most loosely branched states of this species are quite difficult to distinguish from some aspects of *A. tenellus,* with which Rydberg rightly associated it in his sect. *Tenelli.* It must be recalled, however, that Jones (1923, pp. 91, 97–8) had already defined a subsect. *Miseres* within his sect. *Inflati* composed solely of *A. vexilliflexus* and *A. microcystis* (his *A. pauciflorus* and *A. miser,* respectively), tacitly acknowledging the fact that some plants of these two species are virtually indistinguishable until the fruit has formed. Despite its inflated pod, which is moreover deciduous when ripe, *A. microcystis* is unquestionably a close relative of *A. vexilliflexus,* and shares with *A. tenellus* a feature otherwise unique in the genus, a tendency for the stipules to turn black on drying. Because of subtle differences in growth-habit, *A. Bourgovii* has been excluded from the present group by recent workers, although it shares nearly every technical feature of importance with *A. tenellus.* Jones (1923, p. 89) aligned *A. Bourgovii* with the very different *A. leptaleus* in his sect. *Debiles;* Rydberg (1923, p. 186; 1929, p. 265) established for it, and some wholly unrelated arctic mesophytes with buried root-crown and deciduous fruits, a sect. *Bourgoviani* supposedly set off from the *Tenelli* by a black-hairy pod, a character inconstant even at the specific level. Gray, even without ripe pods, presciently described *A. Bourgovii* as a member of the so-called *Homalobi Genuini* of which *A. tenellus* (or *A. multiflorus* Gray) is the historic typus. Finally, *A. vexilliflexus* var. *nubilus* so very closely resembles *A. Kentrophyta* in all technical characters except the foliage, and in superficial appearance so closely simulates some alpine forms of its var. *implexus,* as to have been mistaken until recently for that species. I can only interpret these resemblances as a direct clue to the relationships and probable origin of the *Submonospermi (Kentrophyta).*

The *Ervoidei* are nearly all polymorphic or variable species, in which processes of adaptive and selective evolution seem to be actively at work. The apparent simplicity of a small, few-seeded, unilocular pod compressed sideways in the manner of a vetch or lentil has been considered a primitive feature, but in the genus *Astragalus* it is very likely a symptom of advanced specialization. The *Submonospermi,* or kentrophytas, with their modified and eventually spinescent foliage, lenticular deciduous pod, and (in some cases) dolabriform hair-attachment, doubtless represent a terminal, elsewhere unprecedented evolutionary achievement.

Key to the Subsections of Sect. Ervoidei

1. Leaflets (5) 7–25, all jointed to the rachis (if the terminal one decurrent, then 4 lateral pairs present), obtuse or acute but never mucronate or spinulose at apex, never becoming stiff or prickly in age; *racemes* mostly 4–20-flowered, either pedunculate or subsessile, but if subsessile the flowers at least 4, commonly more (2)
   2. Pod (either sessile or stipitate) persistent and dehiscent on the raceme, the body narrowly linear-oblong or elliptic in profile, never inflated, laterally compressed and bicarinate by the sutures ..... XX (i). Subsect. *Ervoidei*
   2. Pod (sessile) deciduous when ripe, plumply ovoid- or obovoid-subglobose, blad-

dery-inflated ..... XX (ii). Subsect. *Microcystei*

1. Leaflets 3–9, all linear-elliptic or linear, gradually contracted at base and decurrent into the rachis, mucronate or spinulose at apex, often becoming recurved, stiff and prickly in age; *racemes* 1–3-flowered, commonly subsessile in the leaf-axils (rarely pedunculate). Pod lenticular or lance-oblong in profile, not inflated, ± laterally compressed, deciduous ..... XX (iii). Subsect. *Submonospermi*

XX (i). Subsectio Ervoidei

Strongly caulescent (rarely subacaulescent), the stems simple or repeatedly branching, erect, ascending, or prostrate, sometimes loosely or even densely matted; *vesture* basifixed; *leaflets* all (or all but the terminal one) jointed to the rachis: *pod* as given in the key.—Spp. 3, widely dispersed in interior eastern North America, from Yukon to Manitoba, south to Nevada and New Mexico.

Astragalus sect. Ervoidei (T. & G.), comb. nov., based on *Homalobus* sect. *Ervoidei* (lentil-like) T. & G., Fl. N. Amer. 1: 350. 1838—Sp. lectotypica: *H. multiflorus* (Pursh) T. & G. = *Ervum multiflorum* Pursh = *Astragalus tenellus* Pursh.

Homalobus (flat-pod, the plants "with the aspect of *Phaca* and nearly the legumes of *Vicia*") Nutt. ex T. & G., Fl. N. Amer. 1: 350. 1838.—Generitypus: *H. dispar* Nutt., based on *Orobus dispar* Nutt. = *A. tenellus* Pursh.—*Astragalus* sect. *Homalobi* Gray subsect. *Genuini* (pro parte) Gray in Proc. Amer. Acad. 6: 225. 1864. *Astragalus* sect. *Homalobus* (Nutt.) Sheld. in Minn. Bot. Stud. 1: 117. 1894. *Astragalus* subgen. *Homalobus* (Nutt.) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Nev. Utah): 321. 1925.

Homalobus sect. *Tenelli* Rydb., Fl. Colo. 208. 1906 & in Bull. Torr. Club 50: 181. 1923. —Sp. typica: *H. tenellus* (Pursh) Rydb. = *A. tenellus* Pursh.

Homalobus sect. *Bourgoviani* Rydb. in Bull. Torr. Club 50: 186, pro parte. 1923.—Sp. typica: *H. Bourgovii* (Gray) Rydb. = *A. Bourgovii* Gray.

Key to the Species of Subsect. Ervoidei

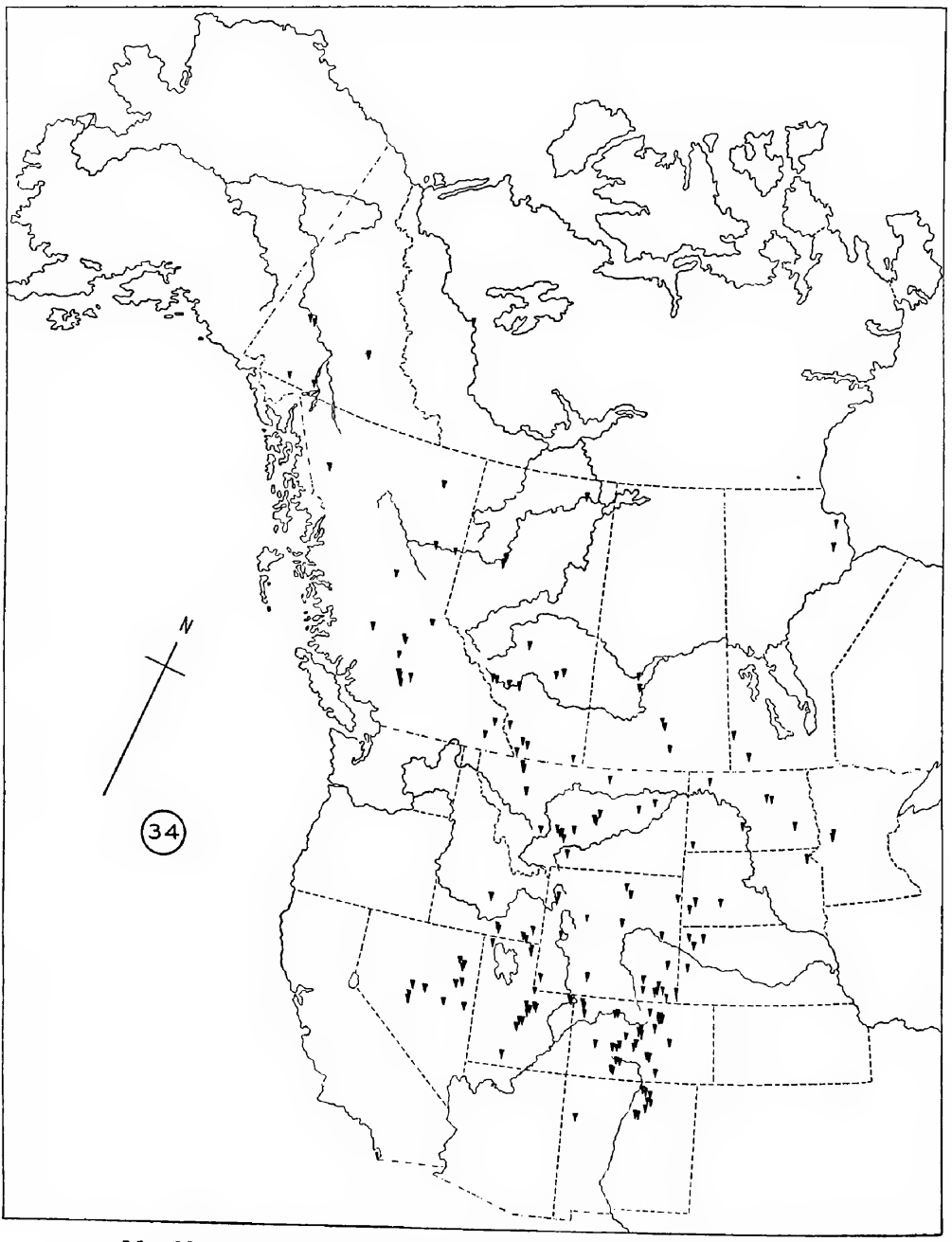
1. Stems nearly always branched or spurred at and often beyond the middle; *peduncles* 0.5–3 (4) cm. long; *keel* 3–5.7 (6.5) mm. long. Pod either sessile or stipitate, flowers white or purple, widespread in the range of the section (2)
   2. Pod stipitate, the stipe 0.6–7 mm. long, commonly well-developed and at least 1.5 mm. long; *petals* commonly white or whitish except for the maculate keel-tip, rarely suffused with pale pink, bright pink-purple only in the Rocky Mountains of s. Colorado; range of the subsection ..... 90. *A. tenellus*
   2. Pod sessile or nearly so, the stipe vestigial if present and not over 0.3 mm. long; *petals* commonly bright pink or purple, whitish with maculate keel-tip only in n.-w. Wyoming and in the high mountains of centr. Idaho; Canadian Rocky Mountains to S. Dakota, Wyoming, and Idaho ..... 91. *A. vexilliflexus*
1. Stems simple above the immediate base; *peduncles* 3–10 (14) cm. long; *keel* 6.5–8.8 mm. long; *pod* shortly stipitate; *petals* purple or all purple-tipped; Canadian Rocky Mountains to w. Montana and n. Idaho ..... 92. *A. Bourgovii*

90. Astragalus tenellus

Erect or diffuse, variable in stature but commonly slender and densely leafy, with a thick, woody taproot and knotty root-crown or shortly forking caudex at soil-level, thinly strigulose (pilosulous) nearly throughout with fine, straight, nearly always appressed (exceptionally ascending) hairs up to (0.2) 0.25–0.6 (0.7) mm. long, the herbage green, sometimes turning black when dried, the leaflets glabrous above, the inflorescence often black-pubescent; *stems* several or numerous, either erect and ascending in bushy clumps, or diffusely assurgent, or (especially at great elevations) prostrate and radiating with ascending tips, (0.8) 1.2–4.5 (5) dm. long, simple and leafless at base, nearly always branched or spurred upward from the first leafy to the first floriferous axil, the branches sometimes again branched or spurred, the spurs (upward) often paired with a peduncle, or the peduncles (distally) borne in unequal pairs together in the leaf-axils, the shorter one inserted between the leaf and the longer one, representing an inhibited branchlet; *stipules* 1.5–8 mm. long, ± dimorphic, the lowest ones firmly papery,

brown or blackish, amplexicaul and connate through half to nearly their whole length into a loose, campanulate, or an appressed, subcylindric sheath (this sometimes fragile and ruptured in age), the median and upper ones progressively less connate, mostly united through less than half their length or at base only, occasionally semiamplexicaul and free, with lanceolate or lance-acuminate, herbaceous or submembranous, green, pallid, or at length nigrescent, mostly erect blades; *leaves* (1) 2–8 (9.5) cm. long, all but the lowest ones sessile or nearly so, with (7) 11–21 (25) crowded or moderately distant, linear-oblong, -elliptic, truly linear, oblanceolate, lance-oblong, -elliptic, or (rarely, and mostly in some lower leaves) oblong-obovate or even obovate-cuneate, mostly acute or obtuse and mucronulate, rarely obtuse or truncate-emarginate, flat and thin-textured or stiffer and involute leaflets (1) 3–22 (27) mm. long, the midrib prominent beneath, all jointed to the rachis, but the petiolule sometimes obsolete and the joint of the terminal ones sometimes obscure; *peduncles* slender or filiform, narrowly ascending or incurved, 0.2–3 (4) cm. long, much shorter than either the leaf or the raceme-axis; *racemes* loosely or remotely 4–20 (23)-flowered, the shorter one of a pair often depauperate and only 1–3-flowered, the flowers early ascending becoming horizontal and then declined, the axis ± elongating, (0.5) 1.5–10 (12) cm. long in fruit; *bracts* membranous or subherbaceous, ovate, ovate- or lance-acuminate, 0.5–2.7 (3) mm. long, rather firm, dorsally carinate and sometimes nigrescent in age; *pedicels* very slender, at anthesis ascending, 0.7–2.4 mm., in fruit arched out- and downward, or arched only distally, or rarely divaricate- or contorted-recurved, 0.8–2.7 (3.7) mm. long, tardily disjointing with the ripe fruit; *bracteoles* commonly 2, inserted at or below the base of the calyx, as often lacking in some or all flowers of a plant; *calyx* 2.6–5.2 (6.1) mm. long, thinly to quite densely strigulose with black, mixed black and white, or all white hairs, the subsymmetric disc 0.5–0.8 mm. deep, the pallid or rarely pinkish tube (1.8) 2–2.7 (3.1) mm. long, 1.5–2 (2.4) mm. in diameter, the subulate or linear-subulate teeth 0.7–2.5 (3) mm. long, the whole becoming papery, marcescent unruptured; *petals* white, whitish, or pale cream-color and concolorous, or whitish with lilac keel-tip, the banner and wings rarely veined or suffused with pinkish-lilac, occasionally all lively pink-lavender or -purple; *banner* recurved through ± 40° (further in withering), ovate- or obovate-cuneate, shallowly notched, (5.5) 6–8.8 (10) mm. long, 3.7–5.6 (6) mm. wide; *wings* (5.4) 5.7–7.6 (8.8) mm. long, the claws (1.8) 2–2.8 (3.1) mm., the elliptic or obovate-elliptic obtuse or (when broad) subemarginate, gently incurved blades (3.6) 4–5.8 (6.2) mm. long, 1.4–2.4 mm. wide; *keel* 4.3–5.7 (6.5) mm. long, the claws (1.8) 2.1–2.7 (3.2) mm., the broadly half-obovate or triangular-obovate blades (2) 2.5–3.5 mm. long, 1.4–2.1 mm. wide, abruptly incurved through 90–100° to the rounded, bluntly deltoid, sometimes minutely porrect apex; *anthers* 0.3–0.45 mm. long; *pod* pendulous, stipitate, the straight, slender stipe 0.6–7 mm. long, the body broadly to narrowly oblong-elliptic or elliptic-oblanceolate in profile, straight, or a trifle arched downward, 7–17 mm. long, (2.3) 2.7–4.5 (5) mm. in diameter, cuneately contracted or acuminately tapering at one or both ends, strongly compressed, bicarinate by the filiform but salient sutures, the faces at first flat becoming low-convex with ripening of the seeds, the thin, green but often brown- or red-mottled or -stippled valves becoming papery, dark brown or black, prominently reticulate, sublustrous in age, usually glabrous but (southwestward) not rarely strigulose with white or even black hairs; *ovules* (3) 4–8 (9); *seeds* (seldom observed) brown or greenish-brown, sometimes purple-dotted or -mottled, smooth or nearly so, sublustrous, 2.2–2.8 mm. long.—Collections: 198 (xix); representative specimens cited in the discussion.

Gullied bluffs and knolls on the higher plains and prairies and within the Great Basin, alluvial bottomlands, dry washes, gravel bars of intermittent streams, sometimes (especially northward) on river or lake shores, in the Rocky Mountain and intermountain region ascending through the sagebrush-piñon and oak brush into yellow pine, lodgepole pine, and spruce-fir forest and to stony clay flats in mountain parks, mostly between 1900 and 9500 feet, but lower northward, and reaching 10,500 feet in the Rocky Mountains of Colorado and in the desert ranges of southern Idaho and central Nevada, widespread and locally plentiful from the



Map No. 34. Western Canada and United States. Range of *A. tenellus.*

headwaters of the Pecos, Rio Grande, and Canadian Rivers in northern New Mexico north through the Rocky Mountains to the Peace River in northwestern Alberta and adjoining British Columbia and interruptedly to the Yukon Valley and to the Mackenzie River in latitude 65° N., east across the plains to the Assiniboine River and Churchill District on the west shore of Hudson Bay, Manitoba, westcentral Minnesota, eastern South Dakota, and western Nebraska, extending west of the Continental Divide to the Stikine and Fraser Rivers in British Columbia, the Sawtooth foothills in southcentral Idaho, and around the Colorado Plateau to the Wasatch in Utah and farther, in scattered stations, through the Great Basin to the headwaters of the Reese River in central Nevada; apparently isolated at the head of the Little Colorado River in western New Mexico and at the head of the Sevier in southern Utah.—Map No. 34.—May to August.

ASTRAGALUS TENELLUS (rather delicate) Pursh, Fl. Amer. Sept. 2: 473, pro parte, exclus. fruct. 1814.—"On the banks of the Missouri. *M. Lewis* . . . v. s. in Herb. Lambert."—Holotypus not found at BM; presumably lost.—*Ervum multiflorum* (many-flowered) Pursh, op. cit. 739. 1814.—"In Upper Louisana. *M. Lewis and Bradbury* . . . of this plant I had an imperfect specimen in the Lewisian Herbarium together with some pods of an Astragalus."—Spm. authent., a fragment labeled "*Ervum multiflorum* Ph Supp. Bradbury ex herb. Lambert.," NY!—*Homalobus multiflorus* (Pursh) Nutt. ex T. & G., Fl. N. Amer. 1: 351. 1838. *Astragalus multiflorus* (Pursh) Gray in Proc. Amer. Acad. 6: 226. 1864. *Tragacantha multiflora* (Pursh) O. Kze., Rev. Gen. 942. 1891. *Homalobus tenellus* (Pursh) Britt. in Britt. & Br., Ill. Fl. 2: 305, fig. 2151. 1897.

Orobus dispar (dissimilar, i.e., from known spp. of Orobus) Nutt., Gen. 2: 95. 1818.—"On arid hills near Fort Mandan."—Holotypus, labeled in Nuttall's hand "**Homalobus dispar.* (Orobus, Gen. Am.). R. Mts.," BM! isotypus, PH!—*Physondra dispar* (Nutt.) Raf., Atl. Jour. 1[4]: 145. 1832. *Homalobus dispar* (Nutt.) Nutt. ex T. & G., Fl. N. Amer. 1: 350. 1838.

Phaca nigrescens (turning black) Hook., Fl. Bor.-Amer. 1: 143. 1831.—"On the Saskatchewan, to the Rocky Mountanis, and as far north as Fort-Franklin, on the Mackenzie River, in lat. 65°. *Dr. Richardson; Drummond.*"—Holotypus, from "Mackenzie River," *Richardson,* K! isotypus, labeled "*Phaca nigrescens,* Franklin's Journey. Dr. Hooker.," collected presumably by Richardson at Fort Franklin, NY!—No Drummond spm. found at K in 1962.—*Homalobus nigrescens* (Hook.) Nutt. ex T. & G., Fl. N. Amer. 1: 351, in syn. 1838, nom. nud. *Astragalus nigrescens* (Hook.) Gray in Amer. Jour. Sci. II, 33: 410. 1862.

Homalobus Clementis (Frederick Edward Clements, 1874–1945, mycologist, ecologist) Rydb. in Bull. Torr. Club 31: 563. 1904.—Colorado: Sangre de Cristo, 1898, *F. Clements 354* (type)."—Holotypus, NY!—*Astragalus tenellus* var. *Clementis* (Rydb.) Macbr. in Contrib. Gray. Herb., New Ser. 65: 35. 1922.

Homalobus stipitatus (with long-stipitate pod) Rydb. in Bull. Torr. Club 34: 419. 1907.—"NORTH DAKOTA: Upper Missouri (from the data given in Nicollet's report, on the hills somewhere between Fort Pierre and Devil's Lake), 1839, *Geyer* . . . "—Holotypus, NY! presumed isotypus, collected by Geyer on Cheyenne River near Devil's Lake, North Dakota, July 24, 1839, MO!

Homalobus strigulosus (with strigulose pod) Rydb. in Bull. Torr. Club 34: 420. 1907.—"NEVADA: East Humboldt Mountains, 1860, *S. Watson 283* (type)."—Holotypus, *Watson 285,* NY! isotypus, GH!—*Astragalus tenellus* fma. *strigulosus* (Rydb.) Macbr. in Contrib. Gray Herb., New Ser. 65: 34. 1922. *A. tenellus* var. *strigulosus* (Rydb.) F. J. Hermann in Jour. Wash. Acad. Sci. 38: 237. 1948.

Homalobus Standleyi (Paul Carpenter Standley, 1884–1963) Rydb. in Bull. Torr. Club 50: 182. 1923.—"Type collected at Ponchuelo Creek, New Mexico, July 4, 1908, *Standley 4181* . . . "—Holotypus, NY! isotypus, US!

The pulse milk-vetch, *A. tenellus,* is a modest astragalus whose small flowers and fruits are delicately fashioned and delightful at close quarters. The stipitate, laterally flattened pods disposed in very loose, sometimes paired, always very shortly pedunculate racemes are characteristic of the species. Smooth and green when fresh, or green variously patterned with reddish freckles or mottlings, they turn black, shiny, and prominently veiny when ripe. Jones (1923, p. 70) has described the favorite habitats of *A. tenellus* as "woods and shady places," but this gives a false impression of the species as a whole. While *A. tenellus* does occur in the timber belt in the Rocky Mountains and in the mountains of the Great Basin, it is more characteristic of the driest soils and most open places. On the prairies and northward the

species is commonest in gullied badlands and on barren hilltops, and in forested country it is found mostly on sandy or gravelly soils of lake shores and shingly river banks.

The long list of synonyms given above suggests a highly variable or polymorphic species; but considering its immense longitudinal and altitudinal range of dispersal, one might expect a much greater range of variation than exists. The pulse milk-vetch was the first astragalus with compressed, unilocular, lentil-like pod to be discovered, and doubts about its generic status, complicated by independent descriptions of the same plant, account for the early names of Pursh, Nuttall, and Hooker. The remaining names come from Rydberg and were initially applied to one or at best a very few somewhat unusual specimens. The criteria on which Rydberg's *Homalobi* of this group rest are chiefly length of the stipe and presence or absence of pubescence of the pod. Both these features are variable and deserve a word of comment.

The stipe of the pod in *A. tenellus* varies in length not only between populations of otherwise similar plants but also between racemes of the same plant, and even between flowers of the same raceme. I have seen contiguous flowers give rise to stipes varying from 1 to 3 mm., 3.5 to 7 mm., and 0.6 to 1.2 mm. long. Stipes over 5 mm. long are found most commonly toward the northeastern limits of the species-range, but stipes of average length (2–5 mm.) are found in the same region. A long stipe is not correlated with glabrous stems, as Rydberg claimed for *Homalobus stipitatus,* the least considerable of the minor variants he described as species. The shortest stipes (1 mm. long or less) occur chiefly in the southern Rocky Mountains of Colorado and New Mexico, but a stipe of this length is found occasionally as far north as central Montana.

Races of the pulse milk-vetch distinguished by a strigulose pod are confined to two relatively compact areas in the southern Rocky Mountains and the Great Basin: one extends from central Nevada to southeastern Idaho and northeastern Utah; the other from northwestern Colorado southward, mostly west of the Divide, to northern New Mexico, but crossing the continental water parting to include the source valleys of the Arkansas, South Platte, Rio Grande, and Pecos Rivers. In the first of these areas the flowers are consistently very small, white or barely pink-tinged, and the calyx-teeth are always short (0.6–1.8 mm.). Plants of this sort correspond with *Homalobus strigulosus* and would perhaps deserve the status of variety if we did not have examples from Nevada (even from the type region in the East Humboldt Mountains) of equally small-flowered populations with glabrous fruits. The latter are technically indistinguishable from occasional small-flowered specimens of *A. tenellus* gathered at remote points within and far to the east of the Rocky Mountains. On the Wasatch in Utah and again in the northwestern corner of Colorado, colonies of glabrous- and pubescent-fruiting plants occur in close proximity. In the more southern and eastern area outlined above, the forms of *A. tenellus* with pubescent ovary have nearly always larger flowers (banner (6) 7.5–10 mm. long) and longer calyx-teeth (1.8–3 mm.). As already mentioned, the stipe is commonly short in this segment of the range of *A. tenellus,* and thus the short-stipitate, pubescent-fruiting *Homalobus Standleyi* and *H. Clementis* (this further remarkable for its purple petals and often partly or wholly black-hairy pod) stand out as remarkable variations from the norm. However, plants with similarly proportioned calyx and flowers as large have been found near the southern limit of the species at Sante Fe. Some isolated populations with pubescent fruits have flowers of average size and stipes of average length so that, although racial differentiation is clearly at work in the species, subspecific units definable in practice seem not yet to have become stabilized. The more striking minor variants, with synonymy, range, and representative material, are listed below:

M. v. 1. Flowers variable in size, white or whitish, often with maculate keel-tip; stipe of the pod about as long to twice as long as the calyx-tube, the body glabrous, mostly 1–1.7 cm. long (*A. tenellus* Pursh; *Ervum multiflorum* Pursh; *Orobus dispar* Nutt.; *Phaca nigrescens* Hook.)—Range of the species east of the Continental Divide, west to southern British Columbia, the upper Snake River in Wyoming, and southcentral Idaho.—Representative: *Gorman 1115* (ND, NY); *Macoun 59,854* (NY); *J. W. & E. M. Thompson 381* (CAS, NY, WTU); *C. L. Hitchcock 11,895* (CAS, NY, RSA, WS), *18,076* (ID, NY, RSA, WS); *C. L. Porter 5334* (CAS, NY, SMU, TEX); *W. A. Weber 5678* (CAS, SMU, TEX).

M. v. 2. Like the last, but the stipe 2–3 times as long as the calyx-tube *(Homalobus stipitatus).*—Northern Great Plains.

M. v. 3. Flowers comparatively large, with banner 7.5–11 mm. long, the petals white or whitish except for the lilac keel-tip; calyx-teeth 1.8–3 mm. long; stipe shorter than the calyx-tube, often 1 mm. long or slightly less, the body of the pod strigulose or puberulent *(Homalobus Standleyi).*—Southern Rocky Mountains, from the Gunnison Valley to the head of the South Platte in Colorado, south to the sources of the Pecos in New Mexico.—Representative: *Bethel, Willey & Clokey 4171* (CAS, NY, WS); *Ripley & Barneby 7171* (CAS, NY, RSA), *10,415* (CAS, RSA), *10,417* (CAS, RSA).

M. v. 4. Similar to the last, but the flowers purplish to bright purple; stipe of the pod 1

mm. long or less, the body pubescent with black or mixed black and white hairs *(Homalobus Clementis)*.—Local on both sides of the Gunnison-Arkansas divide, Gunnison and Chaffee Counties, Colorado, south to the Sangre de Cristo Range and the upper Rio Grande in Mineral County.—Representative: *C. F. Baker 489* (G, K, NY); *W. A. Weber 9151* (NY, RSA); *Hitchcock, Rethke & Van Raadshooven 4132* (CAS, NY, WS); *Ripley & Barneby 10,187* (CAS, NY, RSA, RM).

M. v. 5. Flowers small, the banner 5.5–8 mm. long, the petals whitish, the keel-tip commonly maculate; calyx-teeth mostly 0.6–1.8 mm. long; stipe of the pod ± equaling or a little surpassing the calyx-tube, the body short (8–12 mm. long), strigulose or puberulent *(Homalobus strigulosus)*.—Nevada and southeastern Idaho, south and east sporadically to the Wasatch in Utah and (transitional to M. v. 3) to the Uinta Basin and Yampa Valley in northwestern Colorado.—Representative: *W. H. Baker 9194* (ID, RSA); *C. P. Smith 2174* (SMU, WS); *Maguire 16,130* (CAS, WS); *Hitchcock & Martin 5655* (NA, NY, WS); *Ripley & Barneby 6216* (CAS, NY, RSA); *Maguire & Holmgren 25,983* (NY, RSA, UTC, WS).—Collections otherwise similar, from the same range, but with glabrous pods: *Marsh 14,949* (NA, NY); *Heller 9166* (NY); *Barneby 4032* (RSA).

Application of the epithet *tenellus* to the pulse milk-vetch follows a tradition unbroken since it was revived in this sense by Sheldon (1894, p. 122) after a period of about thirty years during which *A. multiflorus* (Pursh) Gray had been current. I attribute the revival to Sheldon, for Otto Kunze's slightly earlier *Tragacantha tenella* seems to have been proposed without particular knowledge of the facts involved. Although I am accepting recent usage in these pages, I must express doubts of the legality of the name employed. As Pursh himself tells, *A. tenellus* was described from a mixture of material, a flowering plant from the Missouri collected by Lewis and Clark and "some pods of an Astragalus," described as subterete and beaked, but presumably also bilocular, in order to fulfill the generic character of *Astragalus* as laid down in DeCandolle's *Astragalogia*. While the description of this hybrid *A. tenellus* was in press, or perhaps very recently published, Pursh recognized as conspecific with Lewis's plant a fruiting collection brought back from the same region by Bradbury. This bore pods so far at variance with what was known hitherto in *Astragalus* or *Phaca* that he believed it to represent a different genus. Accordingly Pursh redescribed the Lewis and Bradbury plants together as *Ervum multiflorum*—common and legal practice at the time. I am obliged, however, to examine Pursh's action in the light of retroactive rules of nomenclature. The adoption of a new specific epithet can be interpreted in two ways. It can be said to foreshadow the article providing for the rejection of names based on two or more entirely discordant elements, in which case *A. tenellus* is a nomen confusum. Or alternatively it can be said that Pursh retypified *A. tenellus* in the sense of the fruiting element (which alone would have been thought a genuine *Astragalus* in those days) when he removed the flowering element of the original mixture to the new species of *Ervum*, in which case *A. tenellus* is certainly not the plant so treated here. So far the evidence is all against *A. tenellus* as currently used. But we must take into account that the description was in the first place applicable to our species in every detail other than the two or three words relating to the fruit. If we accept the Lewis and Clark plant as typus of *A. tenellus* and regard the extraneous pod as irrelevant, it becomes possible to treat *Ervum multiflorum* and its synonym *Astragalus multiflorus* as superfluous and illegitimate substitutes, thereby conserving *A. tenellus* in the sense of Sheldon (1894), Britton (1897), Jones (1923), Rydberg (1929 and elsewhere), and of all important floristic works of the past seventy years.

91. Astragalus vexilliflexus

Low, slender, diffusely bushy-branched, low-tufted, or matted, with a thick, sometimes trunklike woody taproot and at length well-developed, suffruticulose caudex, thinly to quite densely strigulose, strigose-pilosulous, or rarely silky-villosulous with fine, straight or sinuous hairs up to 0.3–0.6 (0.8) mm. long, the herbage green, cinereous, or silvery-canescent, the leaflets often medially glabrescent or glabrous above; *stems* several or numerous, incurved-ascending, decumbent, or prostrate, 3–25 (30) cm. long, closely leafy, repeatedly branched or at least spurred at all the lower and middle nodes, sometimes throughout, exceptionally simple above the immediate base; *stipules* 2–5 mm. long, dimorphic, those at the lowest nodes of the year's growth-cycle amplexicaul and connate into a brownish, firmly papery, truncate or bidentate sheath, the median and upper ones connate through half their length or less, sometimes free nearly to the base, with herbaceous, lance- or deltoid-acuminate free blades; *leaves* 1–5.5 cm. long,

shortly petioled or the uppermost subsessile, with (5) 7–13 commonly crowded, elliptic or linear-elliptic, rarely lanceolate, oblanceolate, or narrowly obovate, flat, folded, or involute leaflets acute at both ends, rarely subobtuse and mucronulate distally, in age dorsally carinate by the prominent, pale midrib; *peduncles* 0.5–4 cm. long, slender or filiform; *racemes* loosely 3–7 (11)-flowered, the flowers at full anthesis spreading from ascending pedicels, the axis 0.5–3 cm. long in fruit; *bracts* membranous, narrowly lance-acuminate, 1.5–3 mm. long; *pedicels* filiform or nearly so, at anthesis 1.5–2.5 mm. long, in fruit arched outward or declined, 2–3.5 (4.2) mm. long, tardily disjointing with the calyx and pod; *bracteoles* 0, exceptionally 1 but minute; *calyx* 2.4–4.5 mm. long, strigulose or rarely villosulous with white or sometimes partly black hairs, the disc 0.4–0.7 mm. deep, the campanulate or turbinate-campanulate tube 1.4–2.2 mm. long, 1.4–2 mm. in diameter, the subulate, linear-subulate, or subsetaceous teeth (0.8) 1–3 mm. long; *petals* pink-purple with pale striate eye in the banner, the wing-tips sometimes paler or white, or all lilac, or all but the maculate keel-tip whitish with or without lilac veins in the banner; *banner* abruptly recurved through ±90°, broadly ovate-cuneate, notched or emarginate, (4.3) 5.2–9.3 mm. long, 4–6 mm. wide; *wings* (3.5) 4.4–7.2 mm. long, the claws (0.7) 1.1–2.1 mm., the incurved, obliquely obovate, very obtuse or obscurely emarginate blades of unequal width, the left one broader than the other and concave, its upper margin folded over the keel, the right one plane or nearly so, (3.1) 3.4–5.6 mm. long, 1.5–2.8 mm. wide; *keel* much shorter than the wings, (2.9) 3.4–5.6 mm. long, the claws (0.9) 1.1–2.1 mm., the obliquely obovate blades abruptly incurved through 100–110° into the bluntly deltoid apex; *anthers* 0.3–0.4 mm. long; *pod* loosely deflexed or declined, sessile or nearly so (the stipe, when present, vestigial and not over 0.3 mm. long), the body variable in profile, elliptic, obovate-elliptic, oblong-elliptic, rarely linear-oblong, 4.5–12 mm. long, 1.8–3.5 mm. in diameter, nearly straight but either symmetric or oblique (either the dorsal or the ventral suture then convex and the opposite one nearly straight), commonly cuneate at base, either obtuse and apiculate or acuminate distally, strongly compressed, bicarinate by the slender but salient sutures, the lateral faces at first flat, becoming low-convex as the seeds mature, the thin, green but densely strigulose valves becoming papery and stramineous, not inflexed; *ovules* (4) 5–8 (11); *seeds* olivaceous, dark brown, or black, smooth and somewhat lustrous, 1.8–2.7 mm. long.

Key to the Varieties of A. vexilliflexus

1. Plants variable in stature, but if prostrate and matted then the vesture appressed or subappressed, and the *leaflets* glabrous or medially glabrescent above; *flowers* variable in size and color, but small and whitish only at middle or low elevations in n.-w. Wyoming, and the *pod* then mostly over 5 mm. long ..... 91a. var. *vexilliflexus*
1. Plants densely matted, prostrate; *leaflets* silky-strigulose or villosulous above and beneath; *flowers* small, whitish faintly lilac-tinged or -veined, the banner 5.2–6.2 mm. long; *pod* 3.5–5 mm. long; alpine in centr. Idaho ..... 91b. var. *nubilus*

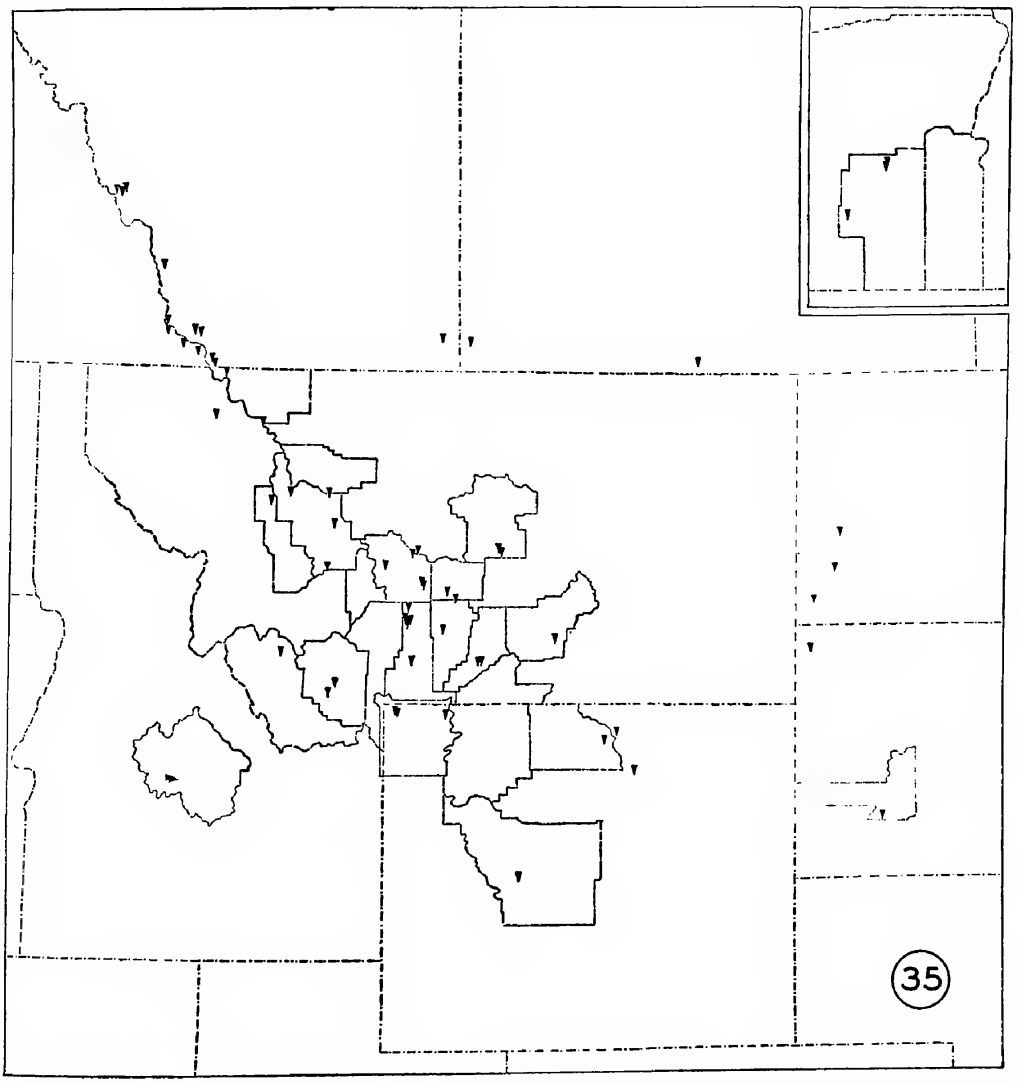
91a. Astragalus vexilliflexus var. vexilliflexus

Loosely matted in exposed places and at great altitudes, becoming diffusely tufted or bushy-branched in the lowlands, the *stems* truly prostrate, decumbent with ascending tips, or ascending, the foliage varying from green and thinly pubescent to cinereous or rarely canescent; *flowers* variable in size as given above, but the petals nearly always pink-purple or clear lilac drying bluish, more rarely only lilac-tipped or -tinged, exceptionally whitish with maculate keel-tip; *pod* either symmetric or oblique in profile, (5) 6–12 mm. long. — Collections: 64 (iv); representative: *McCalla 2146* (NY, WTU); *J. Macoun 10,202* (ND); *Ledingham & Hudson 2384* (NY); *Hitchcock & Muhlick 12,223, 12,359* (CAS, NY, RSA, WS); *Rydberg &*

Bessey 4486 (NY); *Ripley & Barneby 10,962* (CAS, RSA); *C. L. Hitchcock 15,984, 16,180, 16,284* (CAS, NY, RSA); *A. & E. Nelson 5873* (ND, NY); *L. & R. Williams 3288* (CAS, NY, WS, WTU); *H. E. Hayward 552* (NY).

Barren clay bluffs, rocky knolls, and outcrops of shale or sandstone, ascending in open places to rocky slopes, crests, and talus slides in the mountains, 3100–8000 feet, locally plentiful in the northern Rocky Mountains from Banff National Park, Alberta, south, mostly east of the Continental Divide, to the big Horn Mountains, the lower Wind River Valley and Yellowstone Park in Wyoming, east to southern Saskatchewan, the Big Snowy Mountains in Montana and, apparently greatly isolated, to the badlands of South Dakota (Pennington County), west in southwestern Montana to the upper forks of the Missouri and just across the Divide to the head of Deer Lodge Valley. — Map No. 35. — Late May to August.

ASTRAGALUS VEXILLIFLEXUS (with bent banner) Sheld. in Minn. Bot. Stud. 1: 21. 1894, a legitimate substitute for *A. pauciflorus* (few-flowered) Hook., Fl. Bor.-Amer. 1: 149. 1831



Map No. 35. Left, Montana, Idaho, Wyoming, and parts of adjoining states. Range of *A. vexilliflexus*: ◆ var. *vexilliflexus*; ◗ var. *nubilus*. Top right, eastern Oregon. Range of *A. tegetarioides*.

(non Pall., 1800).—"Among rocks in the more elevated regions of the Rocky Mountains, *Drummond.*"—Holotypus, K! isotypi, labeled "*Drummond,* misit Hooker," GH, NY (fragm. in herb. Torr.)!—*Tragacantha pauciflora* (Hook.) O. Kze., Rev. Gen. 947. 1891. *Homalobus vexilliflexus* (Sheld.) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 249. 1900.

Astragalus amphidoxus (doubtful) Blank. in Mont. Agric. Coll. Sci. Stud. 1: 72. 1905.—"Sky High, Unionville, 6000 ft., July 10, 1898, *E. N. Brandegee.*"—Holotypus (MONTU ?), not examined; isotypus, NY! Unionville is a small community a few miles s.-w. of Helena, Montana.—*Homalobus amphidoxus* (Blank.) Rydb. in N. Amer. Fl. 24: 264. 1929.

As described in these pages, the typical variety of the bent-flowered milk-vetch, var. *vexilliflexus,* is a polymorphic aggregate of two or possibly three minor entities which may deserve taxonomic recognition as they become better known. However, it does not seem possible at present to formulate any clear differences between them. In the northern Rocky Mountains, from the limit of the species in Alberta south at montane elevations (mostly over 6000 feet) to the Little Belt and Bridger Ranges in Montana, the prevailing form of var. *vexilliflexus* is a prostrate, more or less densely matted plant with relatively large flowers (banner ± 7–9 mm., keel 4.5–5.5 mm. long) of a lively pink or pinkish-purple hue. The foliage tends to be neat and small, the internodes short, and the whole plant is usually quite thinly pubescent, the foliage only rarely becoming cinereous or silvery. It is the original *Astragalus pauciflorus* of Hooker. In the foothills and intermontane valleys of western Montana, from the Little Belts south to the Yellowstone and Ruby Rivers and Yellowstone Park in Wyoming, var. *vexilliflexus* is represented by a more loosely and diffusely branching plant with somewhat smaller flowers (banner mostly 5–7.5 mm., keel 3.5–4.5 mm. long) varying from pink-purple to whitish tipped with lavender. The internodes tend to be longer than in the montane phase, while the foliage is a little more ample and commonly ashen. The racial situation in Montana is well illustrated by comparison of the series of specimens collected by Hitchcock and Muhlick in the Little Belts *(Nos. 12,223, 12,359)* with their material from the foothills of the Belt and Crazy Mountains *(Nos. 12,076, 13,306)* not far distant. However, some specimens of var. *vexilliflexus* from outlying stations (e.g., from Cypress Hills, Saskatchewan) are intermediate in flower-size, and even in Montana occasional examples of variation in petal-length among members of a single colony serve to blur the ideal differences. Both in montane and lowland plants the pod varies from symmetrically to quite obliquely elliptic in profile, and *A. amphidoxus,* maintained by Rydberg (1929, pp. 257, in clave, 264) chiefly on account of its asymmetric fruit, has no claim to recognition on this score. The typus of *A. amphidoxus* has small flowers (banner 5.6–6.6 mm., keel ± 4 mm. long) described as violet but now faded, and seems to represent a particularly slender phase of the lowland type, despite its origin at a reported elevation of 6000 feet. It may deserve more attention when topotypes can be secured.

Finally, quite local at low elevations in the Big Horn Basin and Wind River Valley, *A. vexilliflexus* reappears in a third phase distinguished by its erect, bushy-branching stems and extremely small, white or whitish flowers (banner ± 4.3–6 mm., keel 3–3.4 mm. long) at least sometimes giving rise to tiny pods as little as 3–5 mm. in length (but these seldom observed). The extreme phase (*Parry, N.-W. Wyoming Exped. 82,* NY; *Ripley & Barneby 7971,* RSA) resembles some forms of *A. tenellus,* although it differs in its truly sessile pod. This form probably will merit recognition as a named variety, although we already have suggestions of intergradation into the lowland Montana form described above. In a preliminary note on variation in *A. vexilliflexus* (Barneby, 1956, p. 484) it was treated as a minor variant; but this course really evaded the problem of racial differentiation in the species which requires extensive field study for solution.

91b. Astragalus vexilliflexus var. nubilus

Prostrate, densely and intricately matted; *herbage* loosely silky-strigulose or villosulous with sinuous hairs up to (0.3) 0.5–0.8 mm. long; *calyx* 3.1–3.8 long, the tube 1.5–1.8 mm., the teeth 1.3–2 mm. long; *petals* whitish, the keel purple-tipped, the banner faintly purple-veined; *banner* 5.2–6.2 mm. long, 4–5 mm. wide; *wings* 4.7–5.9 mm. long, the claws 1.1–1.5 mm., the blades 4–4.8 mm. long, 1.6–2.3 mm. wide; *keel* 3.4–4 mm. long, the claws 1.1–1.5 mm., the blades 2.5–2.8 mm. long, 1.5–1.7 mm. wide; *pod* subsymmetrically lenticular, 3.5–5 mm., long. — Collections: 2 (o); representative: *R. J. Davis 631* (IDS, UTC, WS).

Open stony crests at or above timber line, 10,000–11,000 feet, known only from the White Cloud Range, Custer County, Idaho. — Map No. 35. — August to September.

ASTRAGALUS VEXILLIFLEXUS var. NUBILUS (cloud-born, in reference to the type-locality) Barneby in Amer. Midl. Nat. 55: 484. 1956.—"IDAHO. Open ridge on north of peak to east of Castle Peak, White Cloud Range, Custer Co., 8 August, 1944, *C. L. Hitchcock & C. V. Muhlick* No. 10857 . . ."—Holotypus, CAS! isotypi, IDS, WS, WTU!

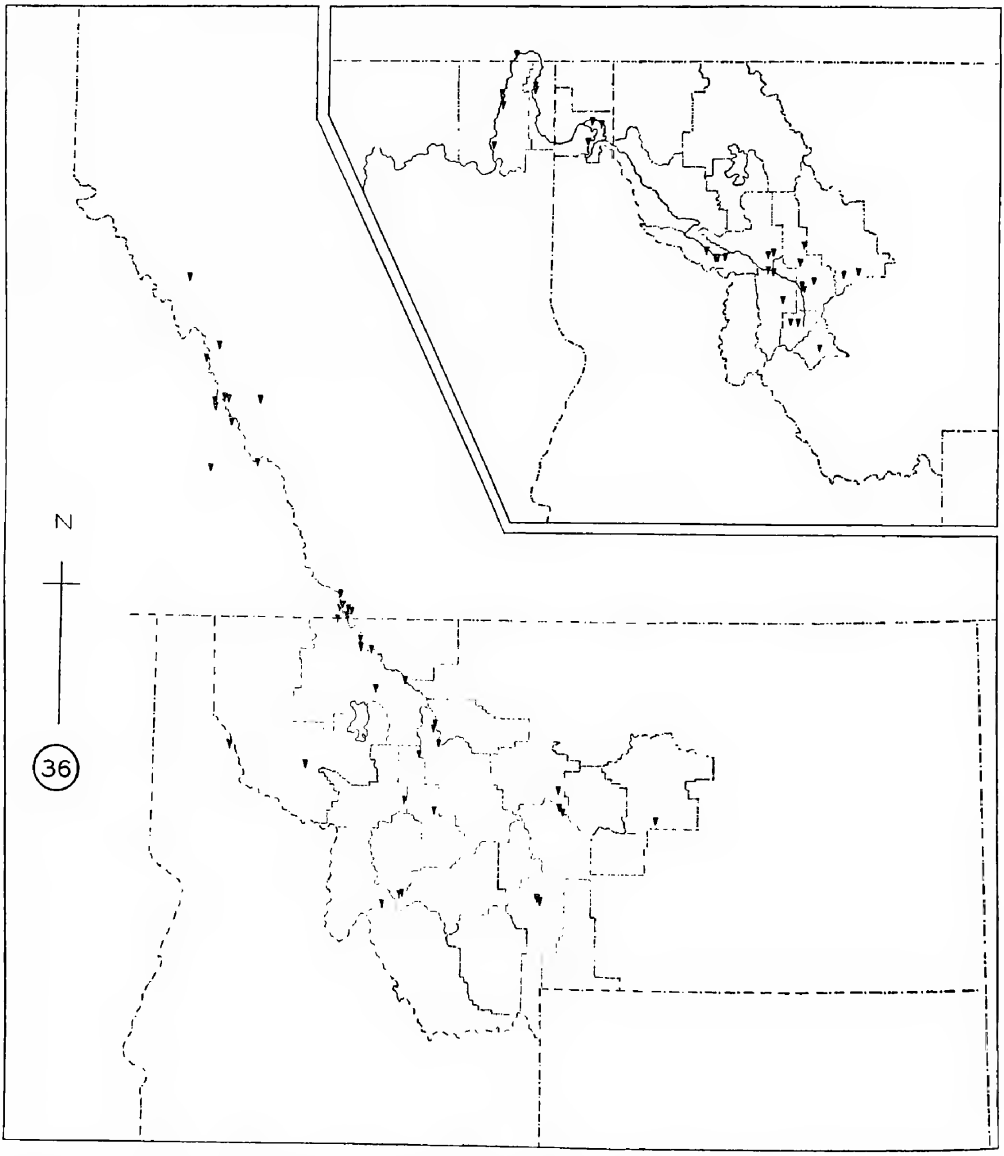
This diminutive variety of the bent-flowered milk-vetch closely resembles some of the more flaccid, pale-flowered forms of the sympatric *A. Kentrophyta* var. *implexus,* apparently differing in little else but the jointed leaflets. The range of var. *nubilus* lies well to the west of the sometimes similarly matted, less densely pubescent, and larger-flowered, montane form of var. *vexilliflexus.* The small, whitish flowers are like those of the third variant of var. *vexilliflexus* mentioned earlier, but the habitat and habit of growth are entirely dissimilar. The typus of var. *nubilus* is subappressed-silky throughout, but Professor Davis's collection from Railroad Ridge is densely villosulous with curly and spreading hairs longer than are known elsewhere in the whole species.

92. ASTRAGALUS BOURGOVII

Low, slender, usually diffuse, with a taproot and loosely forking, at length suffruticulose caudex, thinly to densely strigulose with fine, straight, appressed hairs up to 0.2–0.6 (0.75) mm. long, the stems sometimes subglabrous, the herbage pale or dark green, more rarely silky-canescent, the leaflets glabrous or medially glabrescent above; *stems* usually several, weak, decumbent and incurved-ascending, exceptionally erect, (1) 4–15 cm. or (at low elevations) up to 20–25 cm. long, sparingly branched at base or simple; *stipules* 1–4 mm. long, the lowest, sometimes all, amplexicaul and connate into a papery-scarious, truncate or bidentate sheath, the uppermost ones submembranous, often connate only at base, with lanceolate or lance-acuminate, squarrose blades; *leaves* 1.5–9.5 cm. long, slender-petioled, or the uppermost ones subsessile, with 11–19 ordinarily elliptic and acute, varying in some or all leaves of some plants to oblong, lanceolate, or broadly oval, in each case either acute, mucronulate, or obtuse leaflets 3–17 (19) mm. long, the midvein rather prominent beneath; *peduncles* slender, weak, 3–10 (14) cm. long, commonly decumbent or humistrate in fruit; *racemes* loosely (1) 3–13-flowered, the flowers at first ascending on filiform pedicels, the axis (1) 2–8 cm. long in fruit; *bracts* membranous or scarious, ovate or ovate-acuminate, 0.7–1.7 mm. long; *pedicels* densely black-strigulose, at anthesis 1.5–3 (4) mm. long, in fruit either straight and ascending or arched outward, (2) 2.5–4.5 mm. long; *bracteoles* 0; *calyx* (3.4) 4.5–6.7 mm. long, densely strigulose with black, more rarely partly white, exceptionally all white hairs, the slightly oblique disc 0.5–1.3 mm. deep, the tube (2.6) 3–4.3 mm. long, the broadly subulate to linear teeth (0.8) 1.2–2.9 mm. long, the whole becoming papery-scarious, marcescent unruptured; *petals* pink-purple, or pale (drying yellowish) proximally and tipped with purple; *banner* recurved through ± 50°, ovate- or oval-cuneate, notched, 8–10.5 mm. long, 5–7 mm. wide; *wings* 7.1–9.3 mm. long, the claws 3.3–4.3 mm., the obliquely obovate-oblanceolate, obtuse or emarginate, slightly incurved blades 4.5–6.2 mm. long, 1.8–2.3 mm. wide; *keel* 6.7–8.8 mm. long, the claws 3.2–4.4 mm., the lunately triangular blades 3.8–5.1 mm. long, 1.8–2.4 mm. wide, incurved through 90–100° to the bluntly triangular apex; *anthers* 0.4–0.5 mm. long; *pod* loosely pendulous but apparently ascending from humistrate peduncles, stipitate, the stipe 1–1.5 (2) mm. long, the body elliptic or oblong-elliptic in profile, straight or a trifle decurved, (7) 9–15 mm. long, 3–4.2 mm. in diameter, narrowly cuneate or acuminate at either end (when relatively short, rounded at base), cuspidate at apex, strongly flattened laterally, bicarinate by the slender, salient sutures, the middle of the valves becoming distended by the seeds, the thin, green, densely black-, black and white-, rarely all white-strigulose valves becoming thinly papery, finely reticulate, not inflexed; *ovules* 2–6; *seeds* brown, smooth but dull, 2.2–2.9 mm. long. — Collections: 57 (i); representative: *J. Macoun 65,082, 65,085* (NY); *Hitchcock*

& Muhlick 7914 (NY, WS, WTU); *Leiberg 1470* (CAS, NY, POM); *C. L. Hitchcock 18,003, 18,279, 18,626, 18,754* (ID, NY, WS, WTU); *Ripley & Barneby 10,968* (CAS, NY, RSA); *Flodman 629* (NY).

Rocky crests and summits, talus slides, cliff ledges, and open rocky hillsides, most abundant near and above timber line, but descending along streams and locally persisting on shingle banks, gravel bars, and moist grassy banks at middle elevations, commonly but not exclusively on limestone, 4000-8500 feet, well distributed along the main range of the Rocky Mountains from the sources of the Athabaska River, Alberta, south to the Belt, Bridger, and Anaconda Ranges in western Montana, east to the Big Snowy Range in Fergus County, west to the Swan Range in Missoula County, and to the Coeur d'Alene Mountains in Shoshone County, Idaho; reported by Jones (1923, p. 90) from the Sawtooth Mountains,



Map No. 36. Left, the Rocky Mountains of Alberta and Montana. Range of *A. Bourgovii*. Top right, northern Idaho and parts of adjoining states. Range of *A. microcystis*.

Idaho, and from eastern Montana, both probably, the latter certainly, by error.—Map No. 36.—July to September, flowering in June in the lowland stations.

ASTRAGALUS BOURGOVII (Eugène Bourgeau, 1813–1877, plant collector with Palliser's expedition to the Rocky Mountains in 1858) Gray in Proc. Amer. Acad. 6: 227. 1864.—"Rocky Mountains on the British Boundary, Bourgeau, in Palliser's expedition (ex herb. Kew.)."—Holotypus, GH! isotypi, K (from "Montagnes Rocheuses, région alpine, 19 août, 1858,"), NY, P ("*Phaca* No. 1, *Bourgeau.*")!—*Tragacantha Bourgovii* (Gray) O. Kze., Rev. Gen. 943. 1891. *Homalobus Bourgovii* (Gray) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont): 247. 1900.

The Bourgeau milk-vetch has unusually wide altitudinal tolerance and so it occupies a great variety of ecological niches. Normally, or at least most abundantly, it is a montane plant of open slopes within the forest belt and of stony alpine meadows and rock slides above the limit of trees, where it often assumes a dwarfed, subacaulescent, few-flowered aspect remarkable for its very small distant leaflets. Not uncommonly it descends along streams into the intermontane valleys of western Montana, there becoming taller, more erect, more lushly leafy, and floriferous. As Rydberg (1923, p. 186) remarked, the extremes are superficially very different, but they are connected by a series of intermediate forms. The two collections of J. Macoun from Mount Paget, cited above, provide examples of the extremes growing close together. The species is apparently very sensitive to its immediate environment. The whole inflorescence of *A. Bourgovii,* and especially the fruit, is most often pubescent with black hairs. This dark vesture, of which Rydberg overestimated the systematic importance, combined with purple petals, thin-textured, pendulous pods, and a weakly, straggling habit of growth, is suggestive of some *Oroboidei,* although the pod is here strictly unilocular and very strongly compressed from each side.

XX (ii). Subsectio MICROCYSTEI

Growth-habit and all characters of subsect. *Ervoidei,* but the pod plumply ovoid-ellipsoid, strongly inflated, tardily deciduous; *leaflets* all articulate. — Sp. 1, xerophyte, of the Columbia Basin, northeastern Washington and immediately adjoining British Columbia, east to western Montana where just passing over into the Missouri drainage.

ASTRAGALUS sect. ERVOIDEI subsect. MICROCYSTEI (Gray), stat. nov., based on *Astragalus* sect. *Microcystei* Gray in Proc. Amer. Acad. 6: 219, sens. restr. 1864.—Sp. lectotypica: *A. microcystis* Gray.—*Astragalus* sect. *Microcystis* Sheld. in Minn. Bot. Stud. 1: 131, p.p. 1894. *Phaca* subgen *Chartocystis* sect. *Microcystes* (Gray) Rydb. in N. Amer. Fl. 24: 359, excl. spp. plur. 1929.

Astragalus sect. *Inflati* subsect. *Miseres* Jones, Rev. Astrag. 91, in clave. 1923.—Sp. typica: *A. miser* sensu Jones, non Dougl. = *A. microcystis* Gray.—The subsectional epithet inadmissible in this connection.

Gray's sect. *Microcystei* was defined in terms of a small, subglobosely swollen pod of thin texture and included, with the typical species, the free-stipuled *A. (Inflati) Thurberi* and the mesophytic *A. leptaleus,* both properly excluded from the present group. Other species with pods vaguely similar in form were added to sect. *Microcystei* by Watson (1871, p. 442), Sheldon (l.c.), and finally by Rydberg, in whose summary revision under this heading are nine species belonging to no less than five unrelated sections. The single member of the subsection as narrowly redefined here is very closely related to *A. vexilliflexus,* from some forms of which it can scarcely be separated at the flowering stage.

93. ASTRAGALUS MICROCYSTIS

Low, slender, diffuse or loosely tufted, with a slender or sometimes greatly thickened and trunklike taproot (up to 1.5 cm. in diameter) and loosely forking caudex, strigose-pilosulous with sinous or nearly straight, subappressed, incumbent, or spreading hairs up to 0.3–0.6 (0.7) mm. long, the stems commonly strigulose and the leaves more loosely pubescent, the herbage green or greenish-cinereous, the leaflets medially glabrescent or glabrous above; *stems* many, decumbent and ascending, 0.5–4 (5) dm. long, purplish at base, branched or shortly spurred at the lower and median axils, the branchlets sometimes paired with a peduncle upward; *stipules* 1–5 (6) mm. long, dimorphic, the lower ones amplexicaul and con-

nate into a papery, often nigrescent, truncate or bidentate sheath, the upper ones longer and narrower, very shortly connate or free, with lance-acuminate, often divaricate, herbaceous blades, all thinly pubescent dorsally; *leaves* 1.5–6.5 cm. long, all slender-petioled or the uppermost shortly so to subsessile, with 9–15 narrowly to broadly elliptic, oblanceolate, rarely obovate-cuneate, acute or obtuse leaflets 3–14 (18) mm. long; *peduncles* solitary or rarely 2 (3) together in some upper axils, slender or subfiliform, 1.5–6.5 (8.5) cm. long, mostly shorter, rarely surpassing the leaf, incurved in fruit; *racemes* loosely or remotely 4–12-, exceptionally 15–20-flowered, the flowers early declined, the axis 1.5–4.5 (6) cm. long in fruit; *bracts* submembranous, ovate- or lance-acuminate, 1–2.5 mm. long; *pedicels* slender, at anthesis 0.7–1.5 (2) mm. long, in fruit either straight and spreading or arcuately recurved, 1.2–2.2 (2.5) mm. long; *bracteoles* 0; *calyx* 2.7–3.8 (4.3) mm. long, densely strigulose-pilosulous with white, or black and white hairs, the subsymmetric disc 0.4–0.7 mm. deep, the campanulate tube 1.5–2.2 mm. long, 1.6–2 mm. in diameter, the lance-subulate or subsetaceous teeth 1–2 (2.3) mm. long; *petals* pink or magenta-purple, more rarely whitish tipped with pink, the banner prominently purple-veined, the wing-tips often pallid or white; *banner* recurved through ± 90°, broadly ovate-cuneate, or the blade suborbicular, 5.1–7.8 (8.3) mm. long, 4–6.4 mm. wide; *wings* 4.6–6.5 (6.8) mm. long, the claws 1.4–2 mm., the obliquely obovate or half-obovate, obtuse or emarginate blades 3.5–5.1 (5.5) mm. long, 1.6–2.6 mm. wide, one wider than the other, the left one more strongly incurved than the right and its blade infolded; *keel* 3.7–4.8 mm. long, the claws 1.4–1.8 mm., the half-obovate blades 2.2–3.4 mm. long, 1.4–2.1 mm. wide, abruptly incurved through 95–110° to the bluntly deltoid, obscurely porrect apex; *anthers* 0.3–0.45 mm. long; *pod* spreading from horizontal or declined from ascending raceme-axes, sessile, plumply ellipsoid, obovoid-ellipsoid, or subglobose, bladdery-inflated but only 5–12 (14) mm. long and 4–6 (or when pressed apparently up to 7) mm. in diameter, somewhat oblique, the dorsal suture more strongly convex than the ventral, rounded or obconic at base, obtuse or with a minute conic beak at apex, often merely apiculate by the persistent, incurved style, neither compressed nor sulcate, the valves a trifle fleshy when first formed (and then tending to dry black), becoming papery-membranous, stramineous or brownish, delicately reticulate, shortly but usually densely pilosulous with white and sometimes a few black hairs, not inflexed, the funicular flange 0; *dehiscence* very tardy, after falling, apparently apical; *ovules* 6–8 (9); *seeds* olivaceous, brown, or black, smooth but dull, 2.3–3.2 mm. long. — Collections: 39 (iv); representative: *J. M. Macoun 63,755* (CAS, NY, WS); *H. T. Rogers 544* (CAS, NY, US, WIS, WS, WTU); *MacDougal & Leiberg 816* (CAS, NY, WS); *Hitchcock & Muhlick 9121* (CAS, NY, WS, WTU); *J. W. Thompson 13,675* (CAS, NY, RSA, US, WS, WTU); *Hitchcock & Samuel 2832* (CAS, DS, WS).

Rocky and grassy hillsides, gravelly flats, usually in stiff soils and open places, sometimes on sandy lake or stony river shores, rarely in thin pine forest, 1250–6200 feet, locally common along the upper Columbia River and its affluents from near the mouth of the Spokane, northeastern Washington and adjoining British Columbia, eastward up the Pend Oreille and Clarks Fork to the Big Blackfoot and Deer Lodge Valleys, westcentral Montana, extending just across the Continental Divide into the upper Missouri Valley near Helena. — Map No. 36. — Late April to August.

ASTRAGALUS MICROCYSTIS (with little bladders, of the fruit) Gray in Proc. Amer. Acad. 6: 220. 1964.—"Interior of Washington Territory, Fort Colville to the Rocky Mountains, Dr. Lyall (ex herb. Kew. no. 4, 5, 6)."—Lectotypus, *Lyall 5*, from the Columbia Valley between Fort Colville and Fort Shepherd, in 1860, GH! isotypus, K! paratypi *(Lyall 4 & 6)*, GH, K!—

Tragacantha microcystis (Gray) O. Kze., Rev. Gen. 946. 1891. *Phaca microcystis* (Gray) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 245. 1900.

The least bladdery milk-vetch, *A. microcystis,* and the related *A. vexilliflexus* are a troublesome pair of species. So closely do some flowering specimens of the one simulate the other in all technical characters up to the totally distinctive fruits that material collected at this stage has often been misidentified, with consequent widespread confusion as to the geographic distribution. Thus Jones (1923, p. 98, as *A. miser*) attributed to *A. microcystis* not only a synonym *(A. amphidoxus)* properly belonging to *A. vexilliflexus,* but a range of dispersal extending east and south to the east base of the Rocky Mountains and central Wyoming; at the same time many herbarium specimens of genuine *A. microcystis* from western Montana have found their way into the *A. vexilliflexus* folder. Actually I have have only one positive record of the latter species (Deer Lodge Valley, *Jones in 1905,* POM) from the Pacific slope in Montana, and *A. microcystis* has been traced eastward across the Divide only very locally into extreme southern Lewis and Clark and adjoining Jefferson Counties. The least bladdery milk-vetch seems here to be an immigrant from across the low water parting that separates the Deer Lodge and Missouri Valleys, for its areas of abundance are in the Columbia drainage. Thus in practice there should seldom be any doubt as to the identity even of young material provided its origin is known. A reputed hybrid ("*A. miser* × *pauciflorus*") mentioned by Jones (l.c.) as "about intermediate" between the two species has not been identified at POM where an annotated specimen might be expected; but the term hybrid was employed freely by Jones as a smoke-screen to cover ambiguous specimens, and I must look with skepticism on the existence of such a cross.

A modest, loosely tufted or trailing astragalus, *A. microcystis* is chiefly remarkable for its small, swollen fruits which vary somewhat in outline but are most often broadest a little above the middle and obliquely obovoid. The plants are usually less ornamental than *A. vexilliflexus,* owing to the pallor of the petals and higher ratio of leaf to flower. But occasional plants with relatively ample and purple flowers are pretty enough. The species is not greatly variable, except in superficial matters of stature and luxuriance; it is the plants from the lower elevations and from lake shores that tend to have longer stems, wider leaflets, more numerous flowers, and larger pods than those from stony situations in the mountains.

About the headwaters of Clarks Fork, *A. microcystis* is found in a variety of habitats and is both comparatively common and locally abundant. From Lake Pend Oreille westward, it is rarer and apparently confined to the shores of lakes and rivers. Probably the populations in Idaho and Washington are the progeny of water-borne introductions from the original home of the species in mountain valleys near the Continental Divide.

XX (iii). Subsectio Submonospermi

Caulescent or subacaulescent, perennial but sometimes flowering the first season, commonly dwarf, matted or pulvinate, less often bushy-branched and ± erect; *vesture* either dolabriform or basifixed; *leaves* 3–9-foliolate, the leaflets linear-elliptic or -oblanceolate, continuous with the rachis, keeled dorsally, mucronate or spinulose at apex, often becoming rigid and prickly; *peduncles* short or subobsolete; *racemes* 1–3-flowered, the flowers small, whitish or purple, the obtuse keel 3–6 mm. long; *pod* declined or spreading, sessile, deciduous, 3–10 mm. long, laterally compressed, unilocular, dehiscent apically, basally, and through the length of both sutures, the papery valves separating on falling; *ovules* 2–8; *seeds* 1–3. —Sp. 1, composed of 9 vars., xerophytes, of the intermountain United States, the Rocky Mountains, and extending across the northwestern plains into southern Canada.

Astragalus sect. Ervoidei subsect. Submonospermi (Gray), stat. nov., based on *Astragalus* sect. *Homalobi* subsect. *Submonospermi* Gray in Proc. Amer. Acad. 6: 225. 1864.—Sp. typica: *A. Kentrophyta* Gray.

Kentrophyta Nutt. ex T. & G., Fl. N. Amer. 1: 353. 1838.—Generitypus: *K. montana* Nutt. = *A. Kentrophyta* Gray.—*Astragalus* subgen. *Kentrophyta* (Nutt.) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Nev. Utah): 323. 1925.

94. Astragalus Kentrophyta

Variable in growth-habit, commonly prostrate or diffuse, with repeatedly forking stems forming densely or sometimes quite loosely woven mats, or erinaceous

cushions, 0.5–4 (5) dm. in diameter, or (in some lowland forms) suffruticulose at base, thence bushy-branched or with rigid, erect or assurgent herbaceous stems up to 4.5 dm. long, the whole strigulose, villosulous (villous), or hirsutulous with either basifixed or dolabriform hairs, the herbage commonly cinereous, sometimes greenish or silvery-canescent, often becoming stiff and prickly as the season advances, the leaflets either glabrous or pubescent above; *stipules* either all scarious from the first, or some herbaceous becoming papery or stiff and thorny, all (or at least the lowest of the year's growth-cycle) connate into a bidentate sheath, the upper ones sometimes (rarely all) connate at base only, with erect or divaricate, lance-acuminate, spinulose-tipped or callous-mucronate blades; *leaves* (2) 4–26 mm. long, shortly petioled, with 3–9 pinnately or palmately disposed, linear-elliptic or -oblanceolate leaflets 1–17 mm. long, all continuous with the rachis, grooved ventrally or conduplicate-inrolled, keeled dorsally by the prominent midrib, this running out at apex into a glabrous, pallid or yellowish mucro or spinule (0.2) 0.5–2.5 mm. long; *peduncles* subobsolete or up to 1.5 (3) cm. long, often surpassed by the stipules or concealed in the stipular sheath, the 1–3, loosely racemose, ultimately declined flowers appearing axillary, the raceme-axis little elongating, 0–4 (7) mm. long in fruit, nearly always produced beyond the terminal flower; *bracts* membranous or scarious, ovate-acuminate, lanceolate, or linear-caudate and subsetaceous, 0.8–3.5 mm. long; *pedicels* slender or subfiliform, at anthesis ascending or arched outward, 0.5–1.7 mm. long, in fruit little elongating, arched outward or contorted, not thickened, 0.5–2 mm. long, finally disjointing; *calyx* (2) 2.4–6.5 (8.3) mm. long, strigulose or hirsutulous like the herbage with white, black, or mixed black and white hairs, the subsymmetric disc 0.4–0.8 mm. deep, the obconic-campanulate or hemispherical tube 1.3–2.8 (3.3) mm. long, 1.3–2.7 mm. in diameter, the subulate and subherbaceous, or linear-acuminate and firmly setaceous, often rigid and subspinescent teeth 0.8–3.8 (5) mm. long; *petals* whitish with pink- or purple-tipped keel, or pinkish-lilac throughout, or bicolored, with banner and keel pale to bright pink or purple (drying violet) and white or pallid wing-tips; *banner* recurved through ± 45° sometimes further in withering, broadly obovate-cuneate, flabellate, elliptic-obovate, or oblanceolate, rather deeply notched, 4–10 mm. long; *wings* a little shorter or longer, the blades elliptic or oblanceolate, obtuse or subemarginate, both gently incurved but one of them usually more strongly so than the other and inner margin infolded toward or over the keel; *keel* much shorter, the blades half-obovate or -circular, abruptly incurved through (90) 95–110° to the bluntly deltoid, sometimes obscurely porrect apex; *anthers* 0.25–0.45 mm. long; *pod* declined or spreading, sessile, in profile either subsymmetrically ovate, elliptic, or oblong-elliptic and straight, or lance-acuminate and gently incurved, 3–10 mm. long, (1.4) 1.6–4 mm. in diameter, laterally compressed, bicarinate by the filiform sutures, the faces at first nearly flat becoming distended and convex as the seeds ripen, the thin, green valves becoming papery and stramineous, strigulose; *seeds* brown or ochraceous, sometimes purple-speckled, or greenish-purple throughout, commonly smooth but not highly lustrous, rarely pitted, 1.7–2.2 mm. long.

The kentrophytas are distinguished from all other astragali by the few (3–9) leaflets at once continuous with the leaf-stalk and mucronate or spinulose at apex, and by their racemes, ordinarily subsessile in the leaf-axils, of one to three tiny flowers. The nearly always thick-textured leaflets are further strengthened by a corneous midrib prominent on the lower face; they tend to become rigid and prickly as the season advances, finally withering-persistent on the caudex branches. Easily recognized as forming part of the species in the wide sense, the varieties are most reliably distinguished from one another by the hair-attachment, the shape of the banner, and the number of ovules, characters which require somewhat minute observation, although in some specimens the growth-habit or the size and shape of the pod provide a short

road to identification. The species has differentiated out into two branches: one composed of var. *implexus* and its local derivative var. *danaus*, mostly montane in distribution and doubtless primitive, with basifixed vesture, obcordate banner, and relatively numerous ovules; the other, largely of low or middle elevations and characterized by dolabriform vesture, oblanceolate banner, and few ovules, which has broken up into seven more or less easily defined geographic races. To one familiar with only a few aspects of *A. Kentrophyta*, it must seem a simple matter to recognize two coordinate species corresponding with these two groups of forms, but in reality there are many connecting links and the differential characters mentioned are not perfectly correlated. Thus var. *Kentrophyta* itself combines with the narrow banner, few ovules, and spinescent foliage of the lowland group a hair-attachment only obscurely dolabriform. The pronounced spinescent character of the malpighian-haired group is found at alpine elevations in var. *danaus*, an erinaceous cushion-plant with the pubescence and flowers of var. *implexus*. Furthermore, on the plateaus of central Utah, there is a series of perplexing forms which combine on the same plant the basifixed hairs and broad banner of var. *implexus* (to which they are referred below) with rigid foliage and few ovules, sometimes only three or four in some flowers. The var. *coloradoensis*, a pronounced xerophyte apparently derived from var. *elatus*, has dolabriform hairs together with a pluriovulate pod.

The present account follows in most details a recent revision (Barneby, 1951), in which, due to misunderstanding of the requirements for valid publication of new names, the varieties were subordinated to *A. tegetarius* (= *A. Kentrophyta* var. *implexus*) rather than to the older *A. Kentrophyta*. The varietal key has been altered a little to cover variations observed subsequently, and expanded to include var. *coloradoensis*, now better understood, and the new var. *Douglasii*.

Key to the Varieties of A. Kentrophyta

1. Hairs of the herbage all basifixed; *banner* (beyond the cuneate claw) broadly obovate, obcordate, or suborbicular; *ovules* 5–8, rarely (in Utah) as few as 3–4; *petals* commonly purple or purplish, less often whitish with maculate keel-tip; Rocky Mountains, n. Montana to n. New Mexico, w. to n.-e. Oregon and e.-centr. California (2)
   2. Mature leaves composed of 5–9 leaflets, these either flaccid, or rigid and spinescent, but flaccid in California; range as given above, but extending into California only to the White Mountains, absent from the Sierra ..... 94a. var. *implexus*
   2. Mature leaves mostly palmately 3-foliolate (some lower leaves commonly 5-foliolate), rigid and spinescent, the plants forming prickly cushions; s.-centr. Sierra Nevada, California ..... 94b. var. *danaus*
1. Hairs of the herbage mostly dolabriform, the lower arm sometimes short and obscure, or the attachment of most hairs lateral and basifixed, or (in var. *Douglasii*) all basifixed, but then the blade of the *banner* oblanceolate or narrowly obovate, and the *ovules* only 2–4; *petals* commonly whitish (purple in var. *coloradoensis* and sometimes in var. *elatus*); middle and low elevations, s. Canada e. of the Continental Divide to n. New Mexico, n. Arizona, e.-centr. California, s.-e. Oregon, and s.-e. Washington (3)
   3. Calyx (including the teeth) 2.4–5.2 mm. long, the *teeth* up to 3 mm. long, usually shorter; *pod* either less than 7 mm. long or less than 3 mm. wide; *ovules* 2–4; widespread (4)
      4. Pod ovoid-lenticular, beakless or nearly so (5)
         5. Stipules dimorphic, the lowest connate into a short bidentate sheath, the upper ones longer, connate at base only, with lanceolate or lance-acuminate, often spinulose free blades; *calyx-teeth* 1.5–3 mm. long; e. Oregon to Nebraska and n.-ward (6)
            6. Leaflets glabrous (or medially glabrescent) above, pubescent beneath with basifixed and obscurely dolabriform hairs; *pod* relatively large, (4) 4.5–7 mm. long, 2.4–3.8 mm. wide; s. Wyoming e. of the Continental Divide, to Alberta and Saskatchewan ..... 94c. var. *Kentrophyta*
            6. Leaflets equally pubescent on both sides with obviously dolabriform hairs; *pod* smaller, 3–4.5 mm. long, 1.4–2 mm. wide; s.-w. Wyoming to s.-e. Oregon ..... 94e. var. *Jessiae*
         5. Stipules subhomomorphic, all connate through about half their length; *calyx-teeth* 0.7–1.5 mm. long; n. New Mexico ..... 94g. var. *neomexicanus*
      4. Pod ovate- or lance-acuminate in profile, gently incurved into a definite beak (7)
         7. Plants prostrate, matted; e. and centr. Nevada, or s.-e. Washington (8)
            8. Pubescence basifixed; *calyx-teeth* 2.3–3 mm. long; s.-e. Washington ..... 94d. var. *Douglasii*

8. Pubescence dolabriform; *calyx-teeth* 1.8–2.6 mm. long; Nevada ..... 94f. var. *ungulatus*

7. Plants erect or diffusely branched and assurgent, rarely trailing, but with several or many well-developed internodes (some often longer than the leaves), not matted; widespread ..... 94h. var. *elatus*

3. Calyx at least 6 mm., the teeth 3.4–5 mm. long; *pod* relatively large, 7–10 mm. long, 2.8–4 mm. in diameter; *ovules* 4–8; canyons of the Colorado River in n. Arizona and s.-e. Utah ..... 94i. var. *coloradoensis*

94a. Astragalus Kentrophyta var. implexus

Prostrate, the stems closely and repeatedly forking to form densely, more rarely loosely woven mats or soft, low-convex cushions 0.5–4 (5) dm. in diameter, the internodes often shorter than the stipules, or some of them developed and up to 5–18 mm. long, the herbage usually flaccid, becoming rigid and prickly only in some populations at low elevations late in the season or in the mountains of central Utah; *stems* and herbage cinereous, canescent, or greenish, densely to quite thinly strigulose, villosulous, or rarely villous, the hairs all or largely straight and subappressed, or ascending and either straight or sinuous, or some (all) loosely spreading, the longest up to 0.3–1 (1.2) mm. long, the leaflets pubescent on both sides, more rarely glabrous or medially glabrescent above; *stipules* 2–7 mm. long, the lower ones shorter and more fully connate than the upper ones of the year's growth-cycle, the free blades lanceolate or lance-acuminate, neither rigid nor spinulose; *leaves* (2) 4–15 (20) mm. long, with (3) 5–9 leaflets 1–9 mm. long, these usually crowded, the rachis (0.5) 1.5–4 (7) mm. long, the terminal mucro or spinule (0.2) 0.5–1 (1.5) mm. long, scarcely vulnerant; *peduncles* subobsolete or up to 1.5 (3) cm. long; *calyx* (2) 2.4–5.7 (7) mm. long, the tube 1.2–2.6 (2.8) mm. long, 1.1–2.7 mm. in diameter, the subulate or subulate-setaceous teeth (0.5) 1.9–2.6 (4.2) mm. long; *petals* commonly purple or purplish, sometimes white with pink or purplish keel-tip; *banner* obovate-cuneate, flabellate, or broadly elliptic-obovate, (3.9) 4.5–8 (9.2) mm. long, 3.2–5.6 mm. wide; *wings* (3.8) 4.4–7.4 (8.1) mm. long, the claws (1) 1.2–2.5 (2.7) mm., the blades (3.1) 3.5–5.5 (6.1) mm. long, 2.1–2.4 mm. wide; *keel* 2.9–6 (6.3) mm. long, the claws 1–2.6 (2.8) mm., the blades 2–3.9 (4.2) mm. long, 1.3–2.2 mm. wide; *pod* ellipsoid or oblong-ellipsoid, subsymmetric, (3) 4–8 (9) mm. long, (1.6) 2–2.5 mm. in diameter; *ovules* 5-8, rarely 4 or 3 in some flowers.—Collections: 88 (xvi); representative: *Cusick 2350* (WS), *3221a* (ORE); *J. W. Thompson 14,108* (CAS, NY, WTU); *Hitchcock & Muhlick 10,873* (CAS, NY, WS, WTU), *12,237* (CAS, NY, WTU); *Cronquist 8084* (NY, RSA); *Maguire & Holmgren 25,793* (NY, UTC), *26,141* (NY, RSA, UTC); *Ripley & Barneby 9228* (CAS, RSA), *10,071* (CAS, NY, RSA, UTC); *W. A. Weber 5799* (CAS, RSA, SMU, TEX, WS).

Rocky slopes and crests near and above timber line, descending on gravel slides, open stony hillsides, and talus to barren knolls and benches in the forest and sagebrush zones, mostly between 7500 and 12,000 feet, but coming out to the east foothills of the Rocky Mountains as low as 5000 (Big Horn Mountains, Wyoming) or even 3800 feet (east of Glacier Park, Montana), in soils of various types but mostly on limestone northward and westward and on granites in Colorado, widespread and locally plentiful in the Rocky Mountains from northwestern Montana to extreme northern New Mexico (becoming rarer southward), west to the Wallowa Mountains, northeastern Oregon, and on scattered mountain tops through the Basin Ranges of Utah and Nevada to the White Mountains in east-central California.—Map No. 37.—June to September.

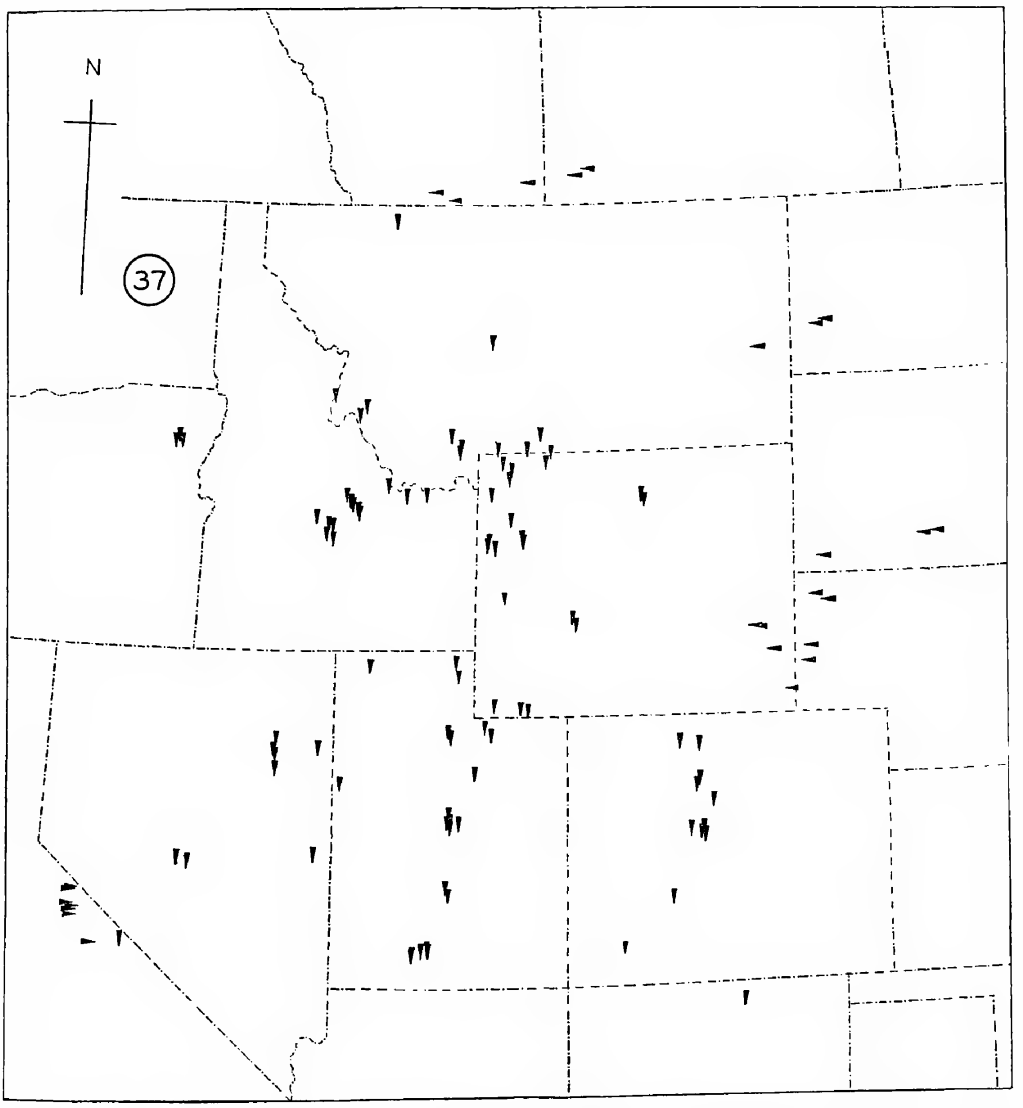
Astragalus Kentrophyta var. implexus (Canby) Barneby in Leafl. West. Bot. 6: 154. 1951, based on *A. tegetarius* var. *implexus* (tangled) Canby ex Port. & Coult., Syn. Fl. Colo.,

Add. 1874.—"South Park, *Canby; Hoopes; Porter.*"—Lectotypus, collected in South Park in August, 1871, by William M. Canby, NY (herb. Canby.)! isotypus, US!

Astragalus tegetarius (mat-forming) Wats., Bot. King 76, Pl. XII, fig. 7–10. 1871.—"Peaks of the East Humboldt and Clover Mountains, Nevada; 11–12,000 feet altitude... [*Watson*] 287."—Holotypus, collected in the East Humboldt Mountains, in 1868, US! isotypi, GH, NY!—*Tragacantha tegetaria* (Wats.) O. Kze., Rev. Gen. 948. 1891. *Homalobus tegetarius* (Wats.) Rydb. in Bull. Torr. Club 31: 563. 1904. *Kentrophyta tegetaria* (Wats.) Rydb. in op. cit. 34: 421. 1907. *Astragalus montanus* var. *tegetarius* (Wats.) Jones, Rev. Astrag. 80, Pl. 5. 1923.

Astragalus tegetarius var. *rotundus* (round, apparently of the pod) Jones in Proc. Calif. Acad. Sci. II, 5: 650. 1895.—"No. 5649b. July 18, 1894, Loa, Utah, 7000° alt... No. 6002. September 6, 1894, Panguitch Lake, Utah, 8400° alt."—Lectotypus, *Jones 5649b,* POM! paratypi *(Jones 6002),* NY, POM, UTC!—*A. Kentrophyta* var. *rotundus* (Jones) Jones, Contrib. West. Bot. 10: 63. 1902. *A. montanus* var. *rotundus* (Jones) Jones, Rev. Astrag. 80, Pl. 5. 1923. *Kentrophyta rotunda* (Jones) Rydb. in Bull. Torr. Club 51: 23. 1924.

Astragalus aculeatus (prickly) A. Nels. in Bull. Torr. Club 26:10. 1899.—"Type specimen, No. 2445, from the higher summits of the Big Horn Mts., near Dome Lake, July 18, 1896."—



Map No. 37. Parts of western United States and southern Canada. Range (in part) of *A. Kentrophyta*: ▼ var. *implexus*; ◗ var. *danaus*; and ◖ var. *Kentrophyta*.

Holotypus, *A. Nelson 2445,* RM! isotypi, GH, MO, NY!—*Kentrophyta aculeata* (A. Nels.) Rydb. in Bull. Torr. Club 32: 665. 1905.

Homalobus Wolfii (John Wolf, 1820–1897) Rydb. in Bull. Torr. Club 31: 562. 1904.—"COLORADO: South Park, 1873, *John Wolf 243* . . ."—Holotypus, NY!—*Kentrophyta Wolfii* (Rydb.) Rydb. in op. cit. 32: 665. 1905.

Kentrophyta minima (smallest) Rydb. in Bull. Torr. Club 34: 420. 1907.—"YELLOWSTONE NATIONAL PARK: August 1884, *Tweedy 83* . . ."—Holotypus, NY!

The mountain kentrophyta, var. *implexus,* is variable in the length and orientation of the hairs on the leaves and stems, in the size and color of the flowers, and in the relative flaccidity or rigidity of the plant-body, especially of the leaflets. The firmness of the plant-tissues appears to be correlated with habitat. Flower-color is at least largely correlated with elevation, for the populations at and above timber line, particularly northward, have petals of a brighter pink- or violet-purple than those at middle elevations, but there are several exceptions to this rule on record. Study of the flower-color and of the comparative rigidity of the leaflets or length of the terminal spinule has shown only feeble correlation with natural patterns of dispersal, but size of the flower and type of vesture do reveal the existence of incipient racial differentiation. The largest flowers are found in the Rocky Mountains northward from the Red Desert in Wyoming; the smallest occur mostly in Colorado and on isolated mountain ranges within and bordering the Great Basin. It would be interesting to learn whether the few small-flowered plants which have been collected in the northern area, such as the typus of *K. minima* from Yellowstone Park and others like it from the headwaters of the Salmon River in Idaho, are truly representative of fixed populations or merely individual variants from particularly exposed habitats, as their generally condensed and thrifty habit of growth suggests. If such were so, it might be reasonable to distinguish a large-flowered northern *"aculeatus"* from a southern *"tegetarius-implexus"*. Disregarding these few northern exceptions, I can bring out the following contrasting flower-measurements (in mm.):

	Northwest Wyoming to Oregon and Montana	Colorado to New Mexico and California
Calyx	3.2–5.7 (7)	2.4–3.4
Calyx-teeth	1.6–2.6 (4)	0.5–1.5
Banner	5.2–9.2	(3.9) 4.5–5.6 (6.2)
Keel	3.9–6.3	2.9–4

In spite of some overlap, the means of variation in the northern and southern Rocky Mountains are substantially different.

In the whole area to the north and west of the Grand-Arkansas watershed in central Colorado, the hairs of the herbage, whether spreading or appressed, are relatively short, the longest 0.3–0.7 mm. long. About the head of the Arkansas and South Platte, especially in South Park, and extending south to Cochetopa Pass in Saguache County and to the Red River canyon in Taos County, New Mexico, the hairs are consistently longer, up to 0.7–1.2 mm. long, the herbage becoming villous-canescent in the extreme state. The epithets *implexus* and *Wolfii* were originally applied to plants of this nature.

94b. ASTRAGALUS KENTROPHYTA var. DANAUS

Densely matted or commonly mounded, the plants up to 15 cm. in diameter, the longest internodes not over 5 mm. long, the foliage rigid and prickly, the leaves and stems loosely strigulose with narrowly ascending hairs up to 0.35–0.55 mm. long, silvery or greenish-cinereous; *stipules* membranous or scarious, 2.5–5 mm. long, the blades of the upper ones acerose; *leaves* 4–15 (20) mm. long, all or all but a few lower ones palmately trifoliolate, the leaflets 3–7 mm. long, the vulnerant spinule (1) 1.5–2 mm. long; *peduncles* 2–6 mm. long; *calyx* 2.4–3.2 mm. long, the tube 1.6–1.9 mm. long, ± 1.5 mm. in diameter, the teeth 0.8–1.3 mm. long; *petals* pale purple, or whitish with purple keel-tip; *banner* 4–5.6 mm. long, 3.2–4 mm. wide; *wings* 3.8–5 mm. long, the claws 1–1.6 mm., the blades 3–3.2 mm. long, ± 1.4 mm. wide; *keel* 3.3–4.1 mm. long, the claws 1.3–1.8 mm., the blades 2.4–2.6 mm. long, ± 1.5 mm. wide; *pod* subsymmetrically lenticular, 3.5–5 mm. long, 2–2.5 mm. in diameter; *ovules* 5–8.—Collections: 9 (o); representative: *Sharsmith 2931, 11,408* (NY); *Eastwood 547* (CAS); *Raven 9864* (CAS, RSA); *Alexander & Kellogg 4058* (NY, WS).

Open gravelly slopes and talus upward from timber line, perhaps descending rarely into bristle-cone pine forest, (10,000) 11,000–12,000 feet, on either granite or metamorphic bedrock, possibly sometimes on pumice, local along the crest and east summits of the Sierra Nevada in Mono County (Sweetwater Mountains; Dunderberg Peak south to Mono Pass) and on the Fresno-Inyo County line at Sawmill Pass.—Map No. 37.—July to September.

ASTRAGALUS KENTROPHYTA var. DANAUS (Barneby) Barneby in Leafl. West. Bot. 5: 154. 1951, based on *A. tegetarius* var. *danaus* (of Mt. Dana) Barneby in op. cit. 5: 95. 1951.—"CALIFORNIA: Glacier Canyon, Mt. Dana, Mono County, *J. T. Howell 20,256* . . . "—Holotypus, CAS! isotypus, RSA!

Compared with var. *implexus*, as this occurs in the White Mountains on the opposite side of Owens Valley, the Sierra kentrophyta is a more rigid plant, the closely forking, basally indurated stems forming small, compact, prickly tufts or domed cushions rather than the prostrate mats of its common relative. The palmately trifoliolate leaves are characteristic, although some quinquefoliolate ones often occur low on each yearly segment of the gradually elongating caudex-branches. The var. *danaus* was first collected in 1863 near the summit of Mt. Dana by William H. Brewer (*No. 1736*, GH).

94c. ASTRAGALUS KENTROPHYTA var. KENTROPHYTA

Decumbent, loosely matted, the longest internodes up to 4–15 mm. long, the plants sometimes flowering as seedlings and the stem then solitary, erect, only 2–5 mm. long, but ultimately freely branching and at length forming mats up to 3 dm. in diameter, the stems and leaves loosely strigulose with ascending, straight or sinuous hairs up to 0.5–0.9 mm. long, mostly attached laterally at base, but nearly always some minutely spurred at base and thus dolabriform, the stems commonly canescent, the leaflets greenish or greenish-cinereous, glabrous or medially glabrescent above, in age stiff and prickly; *stipules* 1.5–6 mm. long, dimorphic, the lowest connate into a short sheath, the upper ones longer, acerose in age; *leaves* (7) 10–25 mm. long, with 5–7, relatively distant, linear-oblanceolate leaflets up to 7–12 mm. long, the terminal spinule 0.5–1.2 mm. long; *peduncles* subobsolete, or up to 2 mm. long, mostly concealed by stipules; *calyx* 3.4–4 mm. long, the tube 1.9–2.4 mm. long, 1.4–1.8 mm. in diameter, the teeth 1.4–2 mm. long; *petals* whitish; *banner* 4–5.5 mm. long, 2–3 mm. wide; *wings* 3.8–5.2 mm. long, the claws 1.5–2 mm., the blades 2.9–3.7 mm. long, 1.1–1.4 mm. wide; *keel* 3–4 mm. long, the claws 1.2–1.9 mm., the blades 2–2.4 mm. long, 1–1.3 mm. wide; *pod* subsymmetrically ovoid-lenticular, (3.5) 4–7 mm. long, (2) 2.4–3.8 mm. in diameter, minutely cuspidate but not beaked; *ovules* 2–3 (4).—Collections: 13 (o); representative: *A. Nelson 3621* (NY, RM); *J. Macoun 10,191* (ND); *C. L. Porter 4308* (RM, SMU, TEX); *Rydberg 79* (NY).

Bluffs, dunes, and gullied ridges in the badlands, mostly below 5000 feet, scattered and apparently not common, known from scattered stations on the northwestern Great Plains from southwestern Wyoming and western Nebraska north to southwestern Saskatchewan and southern Alberta; reported from western Kansas.—Map No. 37.—June to September.

ASTRAGALUS KENTROPHYTA (spiny growth, the old generic name) Gray in Proc. Philad. Acad. 1863, p. 60. 1863, and in Proc. Amer. Acad. 6: 231. 1864, based on *Kentrophyta montana* Nutt. ex. T. & G., Fl. N. Amer. 6: 231. 1838.—"Hills of the Platte, in naked places."—Holotypus, labeled "*Kentrophyta montana*. Platte Hills," BM! isotypus, labeled "*Kentorus *montanus*. R. Mts.," NY!—*Tragacantha montana* (Nutt.) O. Kze., Rev. Gen. 941. 1891. *Astragalus montanus* (Nutt.) Jones, Rev. Astrag. 80, Pl. 5. 1923 (non L., 1753).

Kentrophyta viridis (green) Nutt. ex T. & G., Fl. N. Amer. 1: 353. 1838.—"With the preceding [*K. montana*]."—Holotypus, labeled "*Kentorus *viridis*. R. Mts. Platte.," BM! isotypus, NY!—*Astragalus Kentrophyta* β *viridis* (Nutt.) Hook. in Lond. Jour. Bot. 6: 215. 1847. *A. viridis* (Nutt.) Sheld. in Minn. Bot. Stud. 1: 118. 1895 (non Bge., 1869). *Phaca viridis*

(Nutt.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 374. 1906. *A. tegetarius* var. *viridis* (Nutt.) Barneby in Leafl. West. Bot. 6: 97. 1951.

Through an accident of history Nuttall's kentrophyta was the first form of its species to be described. However, it is probably only a marginal derivative of the biotypically richer and biologically more successful var. *implexus,* which has pioneered onto the higher prairies and there acquired by mutation, balanced against a new lowland environment, some individuality of aspect and a few minor differential characters. It is listed and keyed above among the forms with dolabriform hair-attachment; but laterally affixed hairs are few and hard to find in some individuals, and the basal spur is always short, sometimes obscure in nearly all the hairs. In its whitish petals, narrow banner, and few ovules the var. *Kentrophyta* more nearly resembles var. *Jessiae,* which differs in its smaller fruit and leaflets equally pubescent on both sides. The contrast between linear-oblanceolate and linear-elliptic leaflets emphasized in my revision (Barneby, 1951, p. 98) has not been confirmed in material examined subsequently.

Nuttall's kentrophyta is unquestionably perennial or potentially so, but it seems to be short-lived, rarely persisting long enough to acquire a suffruticulose caudex and often flowering precociously. Seedling plants with almost filiform taproot and solitary, erect stem a few centimeters long are capable of flowering and setting fruit even before the cotyledons have withered.

The record of *A. Kentrophyta* from Kansas ("Wichita County," acc. B. B. Smyth in Trans. Kans. Acad. 15: 61. 1897) has not been confirmed and is omitted from the map.

94.d. Astragalus Kentrophyta var. Douglasii

Prostrate, densely matted, the subcanescent stems repeatedly branched, becoming suffruticulose at base, up to 16 cm. long, the internodes up to 0.8 cm. long, mostly less, the herbage greenish-cinereous, strigulose with appressed or subappressed hairs up to 0.5–0.6 mm. long, becoming prickly, the leaflets pubescent on both sides; *stipules* dimorphic, the lowest short, connate into a bidentate sheath, the upper ones lanceolate, connate at base and drawn out into stiff, spinescent free blades; *leaves* 1–1.7 cm. long, with 5 (7) linear-lanceolate leaflets 5–12 mm. long, the terminal spinule 1.5–2 mm. long; *peduncles* subobsolete; *calyx* 4.7–5.2 mm. long, the tube 2.2–2.4 mm., the spinulose teeth 2.3–3 mm. long; *petals* apparently whitish; *banner* narrowly obovate, about 5.8 mm. long, 3.8 mm. wide; *wings* as long, the claws 2.3 mm., the blades 3.8 mm. long, 1.4 mm. wide; *keel* 4.5 mm. long, the claws 2.3 mm., the blades 2.5 mm. long, 1.3 mm. wide; *pod* lanceolate in profile, very slightly incurved, 5–5.5 mm. long, 2 mm. in diameter; *ovules* 2.—Collections: 3 (o), cited below.

Sandy ground, to be looked for on dunes or eroded river banks, probably at low elevations, known only from "Oregon" or the "Walla Walla region, Washington," very likely within or near the Great Bend of the Columbia River, southeastern Washington, or perhaps adjoining Oregon.

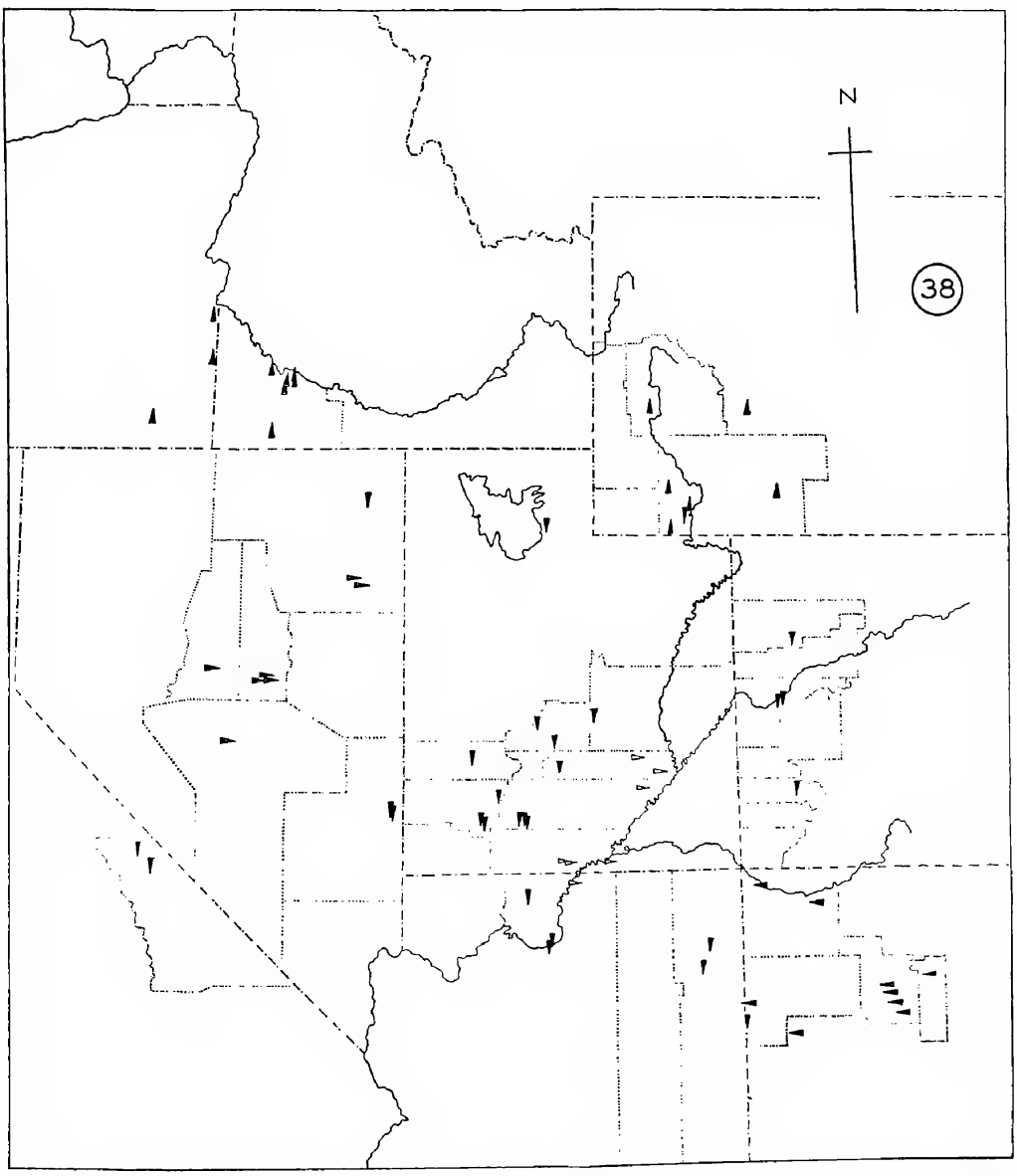
Astragalus Kentrophyta var. Douglasii (David Douglas, 1798–1834), var. nov., habitu var. *Jessiae* et var. *ungulatum,* legumine lanceolato hanc et var. *elatum* propius simulans, sed ab his omnibus pube basifixa absimilis; a var. *Kentrophyta* legumine multo angustiori, foliolisque utrinque strigulosis, a var. *implexi* formis hystricinis albifloris imprimis ovulis binis diagnoscitur. Patria ab aliis speciei varietatibus ut videtur valde remota.—In sand, June 1883, Walla Walla region, Washington Territory, *T. S. Brandegee 734 & Tweedy 600.* Cotypi, mounted together on one sheet, NY (herb. Canby.)! isotypi *(Brandegee 734),* DS, GH, US!

The Douglas kentrophyta was first discovered by David Douglas, presumably either in 1833 (G) or 1830 (K), when he traveled up the Columbia River on his way to the Blue Mountains. The Douglas specimen in the Torrey herbarium is only a fragment of the upper part of a stem, and even though it bears both flowers and fruits, it has been insufficient for analysis. The sheet, which has no more precise label than "Oregon, *Douglas*" (a duplicate gives "Columbia River") was annotated by Rydberg as *Kentrophyta impensa* and was cited in my revision (1951, p. 101) as var. *elatus,* which the lanceolate pod and single pair of ovules suggest. I had overlooked the basal attachment of the pubescence and had not yet seen the Brandegee and Tweedy collections from Walla Walla, at the time still incorporated in the Canby herbarium. Being unable to fit the Washington plant into any previously recognized variety of *A. Kentrophyta,* I am obliged to describe a new entity. The remotely disjunct occurrence of a kentrophyta

near the Great Bend of the Columbia, which occasioned a good deal of wonder in the past, now appears rational. Really exact data of locality is still not available.

94e. Astragalus Kentrophyta var. Jessiae

Diffuse or prostrate, loosely matted, the plants 5–35 cm. in diameter, the longest internodes up to 4–15 (18) mm. long, the foliage becoming stiff and prickly in age, the stems and leaves strigulose with appressed or ascending, sometimes a few loosely spreading hairs up to 0.4–0.7 (0.8) mm. long, cinereous or greenish; *stipules* scarious, 1.5–7 (8) mm. long, the short lower ones connate into a bidentate sheath, the upper ones connate at base and drawn out into narrowly subulate or acicular, commonly rigid and divergent blades; *leaves* 10–17 mm. long,



Map No. 38. Utah, Nevada, and parts of adjoining states. Range (in part) of *A. Kentrophyta*: ▲ var. *Jessiae*; ◗ var. *ungulatus*; ◖ var. *neomexicanus*; ▼ var. *elatus*; and ◊ var. *coloradoensis*.

5-foliolate, the linear-elliptic leaflets 4–10 mm. long, the terminal spinule (1) 1.5–2.5 mm. long; *peduncles* 1–6 mm. long; *calyx* 3.6–5.1 mm. long, the tube 1.6–2.5 (2.9) mm. long, 1.6–1.9 mm. in diameter, the teeth 1.9–3 mm. long; *petals* whitish, the keel-tip and sometimes the banner faintly pink- or lilac-tinged; *banner* 5.2–6.5 mm. long, 3–3.8 mm. wide; *wings* 4.8–6.1 mm. long, the claws 1.4–2.5 mm., the blades 3.2–4.4 mm. long, (1) 1.3–1.9 mm. wide; *keel* 3.6–4.9 mm. long, the claws 1.6–2.7 mm., the blades 2.1–2.8 mm. long, 1.3–1.6 mm. wide; *pod* lenticular or ovoid-lenticular, beakless or nearly so, 3–4.5 mm. long, 1.4–2 mm. in diameter; *ovules* 2 (3).—Collections: 13 (iv); representative: *Maguire & Holmgren 26,234* (NY, WS); *W. H. Baker 10,200* (ID, RSA); *Ripley & Barneby 6526* (CAS, RSA); *Payson & Payson 2568* (NY).

Sandy bluffs, gravelly hilltops, gullied knolls, and dunes or dunelike sandy flats, apparently bicentric in distribution: locally plentiful on alluvial and rhyolitic soils at 2450–3000 feet along the south affluents of the Snake River in Owyhee County, Idaho, and immediately adjoining Malheur County, Oregon; and on shale or sandstone, 6000–6700 feet, in scattered stations within the Green River Basin in Sweetwater and Sublette Counties, Wyoming, extending east just across the Continental Divide to the head of the Sweetwater River in southern Fremont County.—Map No. 38.—June to August.

ASTRAGALUS KENTROPHYTA var. JESSIAE (Peck) Barneby in Leafl. West. Bot. 6: 154. 1951, based on *A. Jessiae* (Jessie Louisa Grant, 1882– , wife and botanical collaborator of Morton E. Peck) Peck in Leafl. West. Bot. 4: 180. 1945.—"Type: *Peck No. 21,220,* from a high gravelly slope 10 miles south of Adrian, Malheur County, Oregon, June 13, 1942."—Holotypus, numbered *21,226* and dated June 15, WILLU! isotypus, RSA!—*A. tegetarius* var. *Jessiae* (Peck) Barneby in Leafl. West. Bot. 6: 96. 1951.

Kentrophyta montana β Nutt. ex T. & G., Fl. N. Amer. 1: 353. 1838.—No locality given, but doubtless collected by Nuttall in Wyoming.—Spm. authent., labeled "*Kentorus montanus* β" and mounted on the same sheet with typus of *K. montana,* NY!

Jessie's kentrophyta is superficially and in most fine details closely similar to the preceding and following varieties. It differs from var. *Kentrophyta* in its more copious pubescence of decidedly two-armed hairs and its smaller or at least narrower fruits; and from var. *ungulatus* chiefly in the pod of subsymmetrically ovate rather than obliquely lanceolate outline. The strictly typical form of var. *Jessiae,* apparently endemic to the Bruneau Desert and vicinity, differs slightly from the Wyoming populations in its somewhat longer and more rigid stipules and calyx-teeth. No kentrophyta is known from the upper Snake River Plains, but one is to be sought on sandy plains and river bluffs in southeastern Idaho.

94f. ASTRAGALUS KENTROPHYTA var. UNGULATUS

Prostrate, forming densely woven mats or low-convex, at length rigid and prickly cushions 8–20 cm. in diameter, the longest internodes not over 1 cm. long, mostly shorter, the stems and leaves densely strigulose with appressed, and some narrowly ascending, nearly straight hairs up to 0.5–0.8 mm. long, cinereous or silvery; *stipules* 1.5–4 mm. long, the lowest in the year's cycle connate into a shortly bidentate sheath, the upper ones with narrowly acuminate, ± acerose free blades; *leaves* 5–13 mm. long, 5 (or the lowest sometimes 3)-foliolate, the linear-elliptic leaflets 3–9 mm. long, the acerose spinule 0.9–1.5 mm. long; *peduncles* 1–4 mm. long, often concealed by stipules; *calyx* 3.6-4.7 mm. long, the tube 1.8–2.1 mm. long, 1.7–1.9 mm. in diameter, the teeth rigidly setaceous or narrowly subulate, 1.8–2.6 mm. long; *petals* whitish, the keel-tip purplish; *banner* 5.2–6.4 mm. long, 3.3–4.2 mm. wide; *wings* 4.9–5.8 mm. long, the claws 1.7–1.8 mm., the blades 3.7–4.5 mm. long, 1.4–1.8 mm. wide; *keel* 3.8–4.2 mm. long, the claws 1.7–1.9 mm., the blades 2.4–2.7 mm. long, 1.3–1.5 mm. wide; *pod* obliquely lance-acuminate in profile, 5–7.5 mm. long, 1.6–2 mm. wide near the obtuse base, thence gently narrowed upward and incurved into a slender, subulate beak surmounted by the persistent style; *ovules* 2–3 (4).—Collections: 7

(iv); representative: *Holmgren 1581* (NY, UTC); *Ripley & Barneby 6198, 9932* (CAS, RSA).

Calcareous gravel or gravelly clay knolls and gullied hillsides in the higher sagebrush valleys of northeastern and central Nevada, 5000–7200 feet (Elko, Eureka, Lander, and northern Nye Counties).—Map No. 38.—May to July.

ASTRAGALUS KENTROPHYTA var. UNGULATUS (clawed, in reference to the talon-shaped pod) Jones in Proc. Calif. Acad. Sci. II, **5**: 650. 1895.—"Watson's specimen in the National Herbarium from Monitor Valley, Nevada . . . and mine from Sprucemont, Nevada."—Holotypus, collected in July, 1868, *Watson 290,* US! isotypi, GH, NA, NY!—*A. montanus* var. *ungulatus* (Jones) Jones, Rev. Astrag. 80. 1923. *Kentrophyta ungulata* (Jones) Rydb. in Bull. Torr. Club 51: 23. 1924. *A. tegetarius* var. *ungulatus* (Jones) Barneby in Leafl. West. Bot. **6**: 100. 1951.

The talon kentrophyta, var. *ungulatus,* combines the matted growth-habit, silvery dolabriform vesture, and white flowers of var. *Jessiae* with the upwardly contracted, distinctly beaked pod of the much taller and coarser var. *elatus.* Its known stations are few and far apart, but the plants are locally plentiful, forming an element of the interesting pseudoalpine flora of knolls on the floor of the high valleys of central Nevada.

94g. ASTRAGALUS KENTROPHYTA var. NEOMEXICANUS

Either decumbent and loosely matted, or erect and assurgent, bushy-branched at base, the stems 4–30 (40) cm. long, the longest internodes up to 4–15 (20) mm. long, the stems and stiff, prickly, greenish-cinereous leaves strigulose with appressed hairs up to 0.35–0.7 mm. long; *stipules* scarious, 1–1.5 (2.5) mm. long, all connate through ± half their length, the blades deltoid or triangular-acuminate; *leaves* 8–22 mm. long, mostly 5-foliolate, the linear-elliptic leaflets 3–13 mm., the spinule 0.5–1 mm. long; *peduncles* 1–3 mm. long; *calyx* 2.4–3.3 (3.7) mm. long, the teeth 0.7–1.3 (1.5) mm. long; *petals* whitish; *banner* 4.8–5.2 mm. long, 2.2–2.8 mm. wide; *wings* 4.5–5.5 mm. long, the claws 1.3–1.7 mm., the blades 3.4–4.2 mm. long, 1.3–1.5 mm. wide; *keel* 3.2–3.7 mm. long, the claws 1.2–1.7 mm., the blades 2–2.5 mm. long, ± 1.2 mm. wide; *pod* subsymmetrically ovoid, minutely apiculate but not beaked, 3–4 mm. long, 1.8–2.4 mm. wide; *ovules* 2–3.—Collections: 10 (ii); representative: *Standley 7850* (NY, US); *Barneby 12,827* (CAS, NY, RSA).

Gullied bluffs, badlands, and dunes, 5300–6900 feet, locally plentiful on both slopes of the Continental Divide in northwestern New Mexico, from the upper San Juan River south to Inscription Rock, east to the Rio de las Vacas and upper Rio Grande in Sandoval and Santa Fe Counties.—Map No. 38.—June to September.

ASTRAGALUS KENTROPHYTA var. NEOMEXICANUS (Barneby) Barneby in Leafl. West. Bot. **6**: 154. 1951, based on *A. tegetarius* var. *neomexicanus* (of New Mexico) Barneby in op. cit. **6**: 99. 1951.—"NEW MEXICO: McKinley Co.: Navajo Experiment Station, *Eastwood & Howell 6839.*"—Holotypus, collected September 18, 1938, CAS!

The New Mexican kentrophyta presents a combination of habital and fruiting characters almost exactly the reverse of that described under var. *ungulatus.* Here the pod is like that of var. *Jessiae,* small, symmetrically ovoid-lenticular and beakless, but the stems of mature plants are commonly well developed and form low, prickly bushes comparable to the more diffuse forms of var. *elatus.* The populations of var. *neomexicanus* are variable in growth-habit, however, which is sometimes of the prostrate, loosely matted type characteristic of var. *Kentrophyta.* The variety is very like the latter but differs in its closely appressed vesture, nearly homomorphic stipules, and tiny pods.

Fragments of var. *neomexicanus* were collected as early as 1847 near Santa Fe by August Fendler, and good specimens a few years later by Bigelow, when Whipple's party was encamped at Inscription Rock.

94h. ASTRAGALUS KENTROPHYTA var. ELATUS

Suffruticulose and often bushy-branched at base, with ± rigid, erect, assurgent, or more rarely diffuse and trailing, herbaceous stems (1) 1.5–4.5 dm. long,

the internodes mostly developed and up to 1.5–5 cm. long, some of them usually longer than the stiff, prickly, early recurving leaves, the stems and herbage strigulose with appressed or narrowly ascending hairs up to 0.5–1 mm. long, cinereous or canescent, the stems sometimes more densely pubescent than the leaves and canescently villosulous; *stipules* (1) 1.5–12 mm. long, the short, scarious lower ones connate into a bidentate sheath, the upper ones lance-acuminate, herbaceous becoming stiffly papery, connate at base only, thence drawn out into spinescent, divaricate or recurved blades; *leaves* 1–2.6 cm. long, (3) 5–7-foliolate, the linear-elliptic leaflets (2) 5–15 (17) mm. long, either glabrous or pubescent above, the terminal spinule 1–2.5 mm. long; *peduncles* 1–6 mm. long, nearly always shorter than the stipules; *calyx* 3.4–4.4 mm. long, the tube 1.8–2.3 mm. long, 1.6–1.9 mm. in diameter, the teeth 1.5–2.4 mm. long; *petals* whitish, or faintly purple-veined or -tinged; *banner* 4.8–6.2 mm. long, 3.2–4.1 mm. wide; *wings* 4.5–5.6 mm. long, the claws 1.3–1.9 mm., the blades 3.6–4.2 mm. long, 1.5–1.9 mm. wide; *keel* 3.7–4.1 mm. long, the claws 1.3–1.8 mm., the blades 2.3–2.6 mm. long, 1.4–1.6 mm. wide; *pod* narrowly ovoid-acuminate, (3.5) 4–7 mm. long, 1.5–2 mm. in diameter, oblique or gently incurved, the ventral suture straight, concave, or at least less convex than the dorsal one, the dorsal suture always convex; *ovules* 2–4.—Collections: 28 (vii); representative: *Purpus 6275* (NY); *Eastwood & Howell 789, 7178* (CAS); *Ripley & Barneby 4777* (CAS, RSA), *10,269* (RSA); *Parker & McClintock 6323* (NY).

Clay knolls, benches, and talus under cliffs or on steep, boulder-strewn hillsides and canyon washes, 5050–7250 feet, rather common in the piñon belt of the Colorado Basin in northern Arizona, southern Utah, and western Colorado, where associated with red or white sandstones, extending into extreme northwestern New Mexico and into the Green River Basin in southwestern Sweetwater County, Wyoming (where sympatric with var. *Jessiae*); also north and west in Utah through the Sevier Valley, sometimes on limestone or rarely eruptive bedrock, to eastern Nevada; apparently isolated, at 10,000 feet, on limestone, in bristlecone pine forest, at the south end of the White Mountains and the adjoining Inyo Mountains in Inyo County, California.—Map No. 38.—June to September.

ASTRAGALUS KENTROPHYTA var. ELATUS (tall) Wats., Bot. King 77. 1871.—"Holmes Creek Valley, Nevada. (281)."—Holotypus, collected in September, 1868, GH! isotypi, NY, US (fragm.). *A. viridis* var. *impensus* (large or strong) Sheld. in Minn. Bot. Stud. 1: 118. 1894, an illegitimate change of epithet. *A. viridis* var. *elatus* (Wats.) Ckll. in Bot. Gaz. 26: 437. 1898. *A. Kentrophyta* var. *impensus* (Sheld.) Jones, Contrib. West. Bot. 10: 63. 1902. *Kentrophyta impensa* (Sheld.) Rydb. in Bull. Torr. Club 32: 665. 1905. *A. impensus* (Sheld.) Woot. & St. in Contrib. U. S. Nat. Herb. 19 (Fl. New Mex.): 369. 1915. *A. montanus* var. *impensus* (Sheld.) Jones, Rev. Astrag. 80, Pl. 5. 1923. *A. tegetarius* var. *elatus* (Wats.) Barneby in Leafl. West. 6: 100. 1951.

In the early spring months an average plant of the tall kentrophyta, var. *elatus*, presents an unpromising tangle of dead stems which mask the new shoots beginning to arise from the suffruticose caudex. In the Colorado Basin the period of active growth starts in late April or May, at a time when the majority of flowering plants are already well advanced, and the stems continue to elongate until late summer, probably for as long as temperature and moisture, derived from deep in the earth, permit. Under favorable conditions racemes are produced at many successive axils upward along the stems, and the flowering season is thus unusually prolonged. At first relatively weak and pliant, the stems early become rigid and wiry, while the stiff, prickly leaves are quickly arched downward and backward toward the stem-axis. The erect or more rarely trailing stems are unusual in the species, because they are simple above the immediate base rather than repeatedly and diffusely branched throughout. The long internodes, lanceolate, ultimately acerose upper stipules, and distally acuminate, few-ovulate pod are characteristic.

Since my revision of the species in 1951, at which time its range (always excepting the irrelevant element from the Columbia Basin described above as var. *Douglasii*) was eminently

a natural one, the tall kentrophyta has turned up in two stations in the White and Inyo Mountains in California, at points notably remote from the nearest recorded locality on the Muddy River in southeastern Nevada, and at unexpectedly great elevations near the 10,000-foot contour. The specimens (*J. & L. Roos 5820, 5962,* RSA) are unusual in having relatively short stems (scarcely 1 dm. long at maturity of the early fruits) and the pods, although distinctly broadest near the base, are less oblique in profile and less distinctly beaked than seen hitherto in var. *elatus*. Possibly they represent a distinct variety.

94i. Astragalus Kentrophyta var. coloradoensis

Either diffuse and loosely matted, or assurgent, the stems up to 12 cm. long, the longest internodes up to 1–1.5 (2) cm. long, the foliage early becoming rigid and prickly, loosely strigulose with sinuous and some straighter, ascending, or largely subappressed hairs up to 0.6–0.9 mm. long, the stems canescent, the leaflets cinereous on both sides; *stipules* 1.5–7.5 mm. long, amplexicaul but connate at base only, with narrowly lanceolate or caudate, at length acerose free blades; *leaves* 9–24 mm. long, with 3–7, mostly 5, linear-elliptic leaflets acuminate at both ends, 4–15 mm. long, the vulnerant spinule 1.5–2.5 mm. long; *peduncles* 2–6 mm. long, the axis of the (1) 2-flowered raceme produced up to 8 mm. beyond the second flower; *calyx* 6–8.3 mm. long, the tube 2.4–3.3 mm. long, 2–2.3 mm. in diameter, the linear-setiform teeth 3.4–5 mm. long; *petals* pale purple; *banner* ovate- or elliptic-cuneate, 7.3–10 mm. long, 4–6 mm. wide; *wings* 6.6–9.6 mm. long, the claws 2.1–2.3 mm., the blades 4.9–6.7 mm. long, 1.5–2.9 mm. wide; *keel* 4.8–6.2 mm. long, the claws 2.3–2.8 mm., the blades 3–3.6 mm. long, 1.7–1.9 mm. wide; *pod* subsymmetrically ellipsoid, lance- or oblong-ellipsoid, (5) 7–10 mm. long, 2.8–4 mm. in diameter, straight or nearly so, shortly acuminate but scarcely beaked; *ovules* 4–8.—Collections: 7 (i); representative: *B. F. Harrison 11,542* (BRY), *11,719* (BRY, RSA, US, UTC), *12,087* (BRY); *McVaugh 14,573* (CAS); *Barneby 13,115* (CAS, NY, RSA).

Canyon benches, sandy bluffs, and talus under cliffs, on sandstone, 3200–5000 feet, local, known only from the canyons of the Colorado River and tributary streams in southeastern Utah (near Hanksville and Burr Desert, Wayne County; Glen Canyon and vicinity, eastern Kane and adjoining San Juan Counties) and extreme northern Arizona (Lee's Ferry, Coconino County).—Map No. 38.—April to June.

Astragalus Kentrophyta var. coloradoensis (of the Colorado River) Jones, Contrib. West. Bot. **10**: 63. 1902 *("Coloradoensis").*—"Lee's Ferry, Arizona, on the Colorado River, June 16, 1890."—Holotypus, POM! isotypus (fragm.), NY!—*A. montanus* var. *coloradoensis* (Jones) Jones, Rev. Astrag. 80, Pl. 5. 1923. *Kentrophyta coloradoensis* (Jones) Rydb. in N. Amer. Fl. **24**: 253. 1929 *("coloradensis").*

The canyon kentrophyta, var. *coloradöensis,* was passed over in the preliminary revision (Barneby, 1951, p. 102) as a large-fruiting variant of var. *elatus,* admittedly a remarkable form but one too little known at the time to permit evaluation of its status. Recently collected plants from Utah have the long, broad pod of the typus combined with a flower and long-toothed calyx substantially longer than anything known hitherto in *A. Kentrophyta,* much larger than those of var. *elatus,* the form of the species with which var. *coloradoensis* has otherwise most in common. The canyon kentrophyta is of shorter duration than var. *elatus* and has a more slender root and caudex. It blooms a month or more earlier and occupies an ecological niche at slightly lower elevations. Not only are the flowers and pods much larger, but the ovules are, at least on the average, more numerous by one or two pairs. The stipules even low on the stems are less strongly connate than in var. *elatus* or in most other forms of *A. Kentrophyta,* but not truly free as Jones described them, unless the sheath is ruptured by expansion of the stem.

XXI. Sectio POLARES

Slender, diffuse or prostrate, caulescent, perennial, with either superficial or buried root-crown or caudex; *vesture* basifixed; *stipules* all, or at least the lowest,

connate; *leaves* imparipinnate, with 7–19 petiolulate leaflets of thin texture; *flowers* few (1–12), loosely racemose or subumbellate, ascending at anthesis, small, the banner ± 7–13.5 mm. long; *pedicels* slightly thickened in fruit, persistent; *calyx-tube* campanulate; *petals* pink-purple or lilac, regularly graduated, the keel-tip obtuse; *pod* loosely ascending (often humistrate), sessile on the slightly elevated receptacle and disjointing when ripe, obliquely ovate, lance- or oblong-elliptic in profile, moderately to greatly inflated, ± laterally or subtrigonously compressed, unilocular, the valves papery-membranous; *ovules* 2–17.—Spp. 2, mesophytes, of wide boreal and arctic dispersal (Alaska to Newfoundland), 1 also in the southern Rocky Mountains (Wyoming, Colorado, extending just into Utah and Nebraska).

ASTRAGALUS sect. POLARES (Rydb.), comb. nov., based on *Phaca* sect. *Polares* Rydb. in N. Amer. Fl. 24: 349. 1929.—Sp. typica: *P. polaris* (Bth.) Rydb. = *A. polaris* Bth.

Astragalus sect. *Debiles* Jones, Rev. *Astrag.* 87, ex parte. 1923.—Sp. typica: *A. debilis* sensu Jones, 1923, and sensu Gray, 1864; an *Phaca debilis* Nutt., nom. dub?

The two species of sect. *Polares* are essentially alike in habit of growth, in details of the flower, and in structure of the fruit, differing from one another chiefly in stature and in dimensions of the pod. The latter is inflated or at least strongly turgid, but the valves are of such thin texture that once dried under pressure the original form is almost impossible to restore. As a consequence, young fruits can easily be misinterpreted as compressed, and each of the *Polares* has been described both in *Phaca* and *Homalobus*.

The sect. *Polares* was designed by Rydberg to accommodate *A. polaris* alone. The commoner species, *A. Bodini* (together with the taxonomically synonymous *A. yukonis, A. stragulus,* and *Phaca Prebblei*) was referred by Rydberg to *Phaca* sect. *Microcystes,* a heterogeneous mixture of boreal mesophytes and southern desert-dwelling astragali which have little in common other than a small inflated fruit. The near kinship of our two *Polares* was appreciated by Jones (1923, l.c.) for he placed them side by side in his sect. *Debiles*. The real affinities of the group are obscure, but each member has more technical points in common with *A. (Ervoidei Microcystei) microcystis* than with any other North American species. It seems pretty certain that *A. microcystis* is a recent piptoloboid derivative of a basically emmenoloboid type represented by *A. tenellus,* and the *Polares* may have arisen independently from another homaloboid source. The section as a unit differs from *A. microcystis* chiefly in its mesophytic nature and in the pod's extremely delicate texture, features which may be of more fundamental import than similarities in the stipules, inflation of the fruit, and other characters. However it is introduced next following the *Ervoidei* for lack of a more appropriate place. The growth-habit of *A. polaris* is strongly suggestive of the genuine *Astragali A. alpinus* and *A. leptaleus,* but the ascending, sessile, deciduous fruit is of a quite different type. The chromosome number 2n = 24 reported for *A. yukonis* (our *A. Bodini*) by Ledingham (1960) is in harmony with the view that this species at least is derived (unlike *A. alpinus*) from an ancient homaloboid source native to the New World.

The epithet *Debiles* Jones antedates *Polares* Rydb. by several years and may prove to be the proper one. Its use is contingent on identification of its typus *Phaca debilis* Nutt., a controversial proposition identified by Gray and Jones with *A. Bodini*. Until the problem of *A. debilis* (discussed in Appendix I) is resolved, the sect. *Debiles* is best held in abeyance. It seems possible that sect. *Vesicularia* Gontsch. will prove to form part of sect. *Polares,* thereby extending the range of the section into eastern Asia. This monotypic section, based on the Kamtchatkan *A. Atlasovii* Kom., was characterized by its tumid, subsessile pod of membranous texture, unilocular and minutely black-strigulose, technically similar to that of *A. Bodini*. No material of *A. Atlasovii* has been available for comparison, but descriptions suggest a plant with the growth-habit of *A. polaris* or *A. alpinus* (of which Hultén, Fl. Kamtch. 97, believed it to be a mere forma).

Key to the Species of Sect. Polares

1. Pod 4.5–10 (12) mm. long, 2–10-ovulate; *stems* above ground 1–4.5 dm. long; *racemes* (2) 3–12 (15)-flowered, commonly loose, the axis commonly 1–9 cm. long ..... 95. *A. Bodini*

1. Pod 15–42 mm. long, 8–17-ovulate; *stems* above ground 1 dm. long or less; *racemes* 1–6-flowered, subumbellate, the axis seldom over 1 (1.3) cm. long in fruit ..... 96. *A. polaris*

95. Astragalus Bodini

Slender, diffuse or prostrate, loosely matted, with a thick woody taproot and pluricipital, sometimes knotty root-crown at or shortly below soil-level, thinly strigulose with straight, appressed or subappressed hairs up to 0.2–0.5 (0.6) mm. long, the herbage green or subcinereous when young, the leaflets glabrous above; *stems* usually many, slender or filiform, 1–4.5 dm. long, branching freely at the lower emersed nodes and often also below ground, exceptionally simple, the ultimate branches sometimes subfiliform; *stipules* 1–7 mm. long, broadly deltoid to ovate, all connate-amplexicaul, the lowest small, membranous becoming papery-scarious, united into a shortly bidentate, cuplike sheath, the longer upper ones connate through ± ½ their length or at base only, with triangular or lance-triangular, subherbaceous, green or purplish blades, the uppermost sometimes free; *leaves* (0.7) 1–7 (9) cm. long, the lower ones slender-petioled, the upper subsessile, with 7–17 (19) commonly well-separated, lance-oblong, oblanceolate, or ovate and retuse or emarginate, or oblong-elliptic and subacute, flat, thin-textured leaflets (1) 2–15 (17) mm. long; *peduncles* slender or filiform, (0.7) 1.5–12.5 (18.5) cm. long, usually all but the uppermost ones surpassing the leaf, but sometimes all or most of them (especially those of slender lateral branchlets) shorter; *racemes* rather compactly to loosely or even remotely (2) 3–15 (16)-flowered, the axis early elongating, (0.2) 0.5–9 (10) cm. long in fruit; *bracts* membranous to subherbaceous, ovate, triangular, or lanceolate, 0.5–2.5 mm. long; *pedicels* ascending or slightly arched outward, 0.7–2.2 mm. long, scarcely elongating in fruit; *bracteoles* 0; *calyx* 3.8–6.1 (7.2) mm. long, strigulose with black or mixed black and white hairs, the subsymmetric disc 0.5–1.1 mm. deep, the tube 2.4–3.7 (4) mm. long, 1.7–2.8 (3) mm. in diameter, the subulate teeth (1) 1.2–2.4 mm. long; *petals* pink-purple to reddish-lilac, drying violet or pallid; *banner* recurved through ± 40–45°, obovate-cuneate, oblanceolate, spatulate- or elliptic-oblanceolate, shallowly or deeply notched, (6.9) 8–11.7 (12.4) mm. long, 3.7–6.8 mm. wide; *wings* (6.6) 7.2–10 mm. long, the claws 2.7–4 mm., the oblong-oblanceolate, linear-elliptic, or elliptic, obtuse or shallowly emarginate, nearly straight or gently incurved blades 4.2–6.9 mm. long, 1.5–2.7 mm. wide; *keel* (5.3) 5.5–8.9 mm. long, the claws 2.7–4.5 mm., the obliquely triangular to lunately half-obovate blades (2.6) 3–5.2 mm. long, 1.8–2.4 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid (or rarely porrect and then sharply deltoid) apex; *anthers* 0.3–0.55 mm. long; *pod* ascending or loosely spreading (mostly humistrate), sessile on a minute gynophore up to 0.8 (1) mm. long (but mostly shorter), the somewhat obliquely ovoid to lance-, ovoid-, or oblong-ellipsoid body (4.5) 5.5–10 (12) mm. long, (2.2) 3–4.5 mm. in diameter, rounded, broadly obconic, or truncate at base, contracted distally into an erect or slightly declined, short-conical or cusplike beak 0.5–2 mm. long, straight or very slightly either in- or decurved, obscurely trigonous, with low-convex lateral faces and nearly flat to depressed and very openly and shallowly sulcate dorsal face, the very thin, greenish, minutely but sometimes quite densely black-, partly white-, or rarely wholly white-strigulose valves becoming papery-membranous, stramineous, subdiaphanous, faintly reticulate, not inflexed; *dehiscence* (seldom observed) apparently primarily basal and upward through the ventral suture, the valves eventually separating; *ovules* 2–10, mostly 5–8; *seeds* smooth, brown, dull or somewhat lustrous, 1.7–2 mm. long.—Collections: 63 (iii); representative: *Cody & Webster 5971* (DAO, NY); *J. P. Anderson 7264a* (DAO, TEX); *Lutz 1055* (RSA, USFS); *Macoun 58,429* (NY); *Cody & McCanse 3252* (CAS, DAO, MO); *Cody 4180* (DAO, GH); *Boivin & Perron 12,790* (DAO); *A. Nelson 135* (NY, RM), *1529* (MO, NY, RM), *3395* (CAS, RM, the robust

extreme), *8694* (NY, RM); *E. & L. Payson 2912* (GH, MO, NY, RM); *Jones 5649* (NY, POM); *Ripley & Barneby 10,517* (CAS, NY, RSA); *W. A. Weber 7916* (CAS, SMU, TEX); *Scoggan 3560* (K).

Of wide but interrupted dispersal, with two main areas of abundance and a few far-flung relic stations eastward: locally common on moist gravelly banks and beds or gravel bars of streams and rivers, sometimes in low sandy meadows, at the edge of aspen or birch thickets, occasionally (near Carcross) on dunes, in Yukon becoming weedy and aggressive in disturbed soil along highway ditches and cleared woodland, recorded mostly from below 2000 feet (but possibly a little higher in some stations), valleys of the middle and upper Yukon and Tanana Rivers in central Alaska and southern Yukon, east to the Mackenzie and Athabaska Rivers in Mackenzie and northern Alberta; lake shores, below 1000 feet, central Manitoba; greatly isolated on turfy seashore at Pistolet Bay, Strait of Belle Isle, northern Newfoundland; and again locally frequent in moist meadows, mountain parks, on banks of mountain brooks, about willow thickets, and more rarely along wayside ditches and on alkaline bottomland, mostly between 6000 and 9800 feet in the southern Rocky Mountains, from the headwaters of the Rio Grande in southern Colorado to the upper forks of the Green and North Platte Rivers in Wyoming, descending (or perhaps washed down and only fleetingly established) along the latter stream into western Nebraska as low as 3700 feet; apparently isolated on the upper Fremont River in southcentral Utah.—Map No. 39.—June to September.

ASTRAGALUS BODINI (the collector) Sheld. in Minn. Bot. Stud. 1: 122. 1894 *("bodini").*—"Near Cheyenne, Wyoming, July, 1889, by J. E. Bodin . . . also collected near Laramie, July, 1889, by Dr. Edw. L. Greene."—Holotypus, dated July 11, 1889, MINN! paratypus *(Greene in 1889),* ND!—*Phaca Bodini* (Sheld.) Rydb. in Bull. Torr. Club 32: 665. 1905 *("Bodinii").*

Astragalus debilis sensu Jones, Rev. Astrag. 88, Pl. 7. 1923; an Gray in Proc. Philad. Acad. 1863, p. 60. 1863, in nota, based on *Phaca debilis* Nutt. ex T. & G., 1838, nom. dub. (cf. Append. I).

Astragalus yukonis (of Yukon) Jones, Rev. Astrag. 89, Pl. 7. (15 Feb.) 1923 *("Yukonis")* —"No 1082 Gorman from Ranch valley near Fort Selkirk . . . No. 626 Eastwood Whitehorse on the Yukon July 23, 1914."—Holotypus, *Gorman 1082,* collected July 5, 1899, POM! isotypus, NY! paratypi, *Eastwood 626,* CAS, NY, UC, WS!—*Phaca yukonis* (Jones) Rydb. in N. Amer. Fl. 24: 360. 1929 *("Yukonis").*

Homalobus retusus (retuse, of the leaflets) Rydb. in Bull. Torr. Club 50: 186. (25 May) 1923.—"TYPE collected at Fort Selkirk, Yukon, July 20, 1899, *Tarleton 128a a & b . . .*"—Cotypi, NY! isotypus *(No. 128a),* US!—*Astragalus visigothicus* (visigothic, or northwestern) Tidest. in Proc. Biol. Wash. 50: 20. 1937, a legitimate substitute (non *A. retusus* Willd., "1794" (n.v.); nec DC., 1802).

Astragalus stragulus (a carpet) Fern. in Rhodora 28: 214. 1926.—NEWFOUNDLAND: . . . Cook Point, Pistolet Bay, July 18, 1925, *Fernald & Gilbert* No. 28,583; August 13, 1925, *Fernald, Gilbert & Hotchkiss* No. 28,584."—Holotypus, *No. 28,584,* GH! isotypi, BM, CAS, G, K, NY, P, US! paratypi, *No. 28,583,* G, GH, NY!—*Phaca stragulus* (Fern.) Rydb. in N. Amer. Fl. 24: 360. 1929 *("stragala").*

Phaca Preblei (Alfred E. Preble) Rydb. in N. Amer. Fl. 24: 361. 1929. *("Prebblei").*—"Type collected on the Athabaska River, Alberta, August 14, 1903, *Prebble* [sic] *& Cary 123 . . .*"—Holotypus, from a place called "Mountain Rapid," US!—*Astragalus Preblei* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937 *("Prebblei").*

The Bodin milk-vetch is found in two widely separated main areas of dispersal, one extending from the Yukon Valley east to the Mackenzie and Athabaska Rivers, the other in the southern Rocky Mountains, and in a few widely scattered, probably relic stations in Manitoba, Newfoundland, and central Utah. By historical accident it was picked up and described independently from three mutually remote points; as a consequence, it has passed in the far Northwest, in western United States, and in Newfoundland under three different names, *A. yukonis, A. Bodini* (or *A. debilis*) and *A. stragulus,* respectively. Since there is a gap of nearly one thousand miles width (or ± twelve degrees of latitude) between the two main areas, it has naturally been assumed that the plants in these two sectors represent separate species. It is

only in recent years that a truly representative sample of *A. yukonis* has been available, or a valid comparison with the better known *A. Bodini* (sens. str.) possible. During the preliminary studies I prepared separate descriptions for the two, in the expectation that real differences would appear when these were compared. The plant of the parks and streamsides of the Rocky Mountains has a superficial root-crown and relatively compact raceme, whereas that of northwest Canada and Alaska has the crown of the root and base of the stems more often than not buried in sand or gravel, and an openly or even remotely flowered raceme of (on the average) slightly fewer flowers. At high latitudes the plants are found in disturbed soils, the aboriginal habitat being along shingly river banks and on gravel bars, and it seems probable that the subterranean position of the caudex is due to shifting of the surface materials. With a range lying between 57° N. and the Arctic Circle, *A. yukonis* is subjected to the long summer day, and this circumstance may be related to the relatively rank or drawn-out and, as it were, etiolated habit of growth as compared with that of the Rocky Mountain plant in Lat. 37–43° N. The important point to be stressed is that the individual flower and individual fruit is essentially the same in both areas. Moreover, there are some extremely slender examples on record from southern Wyoming which are indistinguishable even in habit from the boreal phase (cf. *F. W. Johnson in 1905,* US).

In its range across the northern part of the continent, *A. Bodini* is somewhat polymorphic, the populations differing from one another in number and shape of leaflets, length of the racemes, and color of the hairs on the pod and calyx. Along the upper Yukon River, type-region of *A. yukonis* and *Homalobus retusus,* there are commonly not more than thirteen leaflets, but these may be relatively broad and obtuse to emarginate, or narrow and subacute. Both types of leaflet are found at Fort Selkirk; in fact, the isotypus of *A. yukonis* at NY consists partly of broad-leaved plants, identified by Rydberg as *H. retusus.* On the Athabaska River the leaflets rise to seventeen in number and are commonly of a broad type; but the typus of *Phaca Preblei,* a plant with relatively open racemes, such as occur often in *A. yukonis* west of the Mackenzie Mountains, has nothing more remarkable about it than the white (rather than more usual black) pubescence on the pod.

In Newfoundland *A. Bodini* is known only from the type-locality of *A. stragulus* on the Strait of Belle Isle, close to seventeen hundred miles from the nearest-known station in central Manitoba. At the time Fernald described *A. stragulus,* the material of *A. yukonis* available for comparison was not only extremely scanty but not even truly illustrative of its kind. In order to facilitate discussion, the differential characters stressed by Fernald have been abstracted from his running account, as follows:

Leaflets 7–13, relatively narow, only exceptionally retuse, cinereous; *peduncles* 5–10 cm. long; *racemes* elongating; *flower* small (banner 5 mm. long); *pod* 2–3-seeded ..... *A. yukonis*

Leaflets 9–19, retuse, glabrous above; *peduncles* 0.2–9 cm. long; *racemes* subcapitate; *flower* larger (banner 8–10 mm. long); *pod* 5–8-seeded ..... *A. stragulus*

As already noted, the leaflets in Mackenzie and northern Alberta are often as many as 17 to the leaf. Peduncles of different lengths, varying from a few millimeters to about a decimeter long on the same plant, are known from Yukon as well as Newfoundland. In Alaska and Yukon the banner varies from 7 to 11 mm. (none so short as "5 mm." has been seen), and the flowers are identical in form and proportions to those of the eastern plant. Ovule counts from 2 to 8 (rarely 10) in the West are essentially the same as for *A. stragulus,* and it is certainly untrue that the latter sets more numerous seeds to the pod. The contrasts brought out by Fernald have all proved fallible, but *A. stragulus* does seem to differ slightly in its usually shorter raceme-axis, mostly (2) 5–22 mm. rather than (5) 10–90 mm. long, and in its comparatively low and diffuse stems not known to exceed 1.5 dm. in length. It seems reasonable to interpret the Newfoundland plant as a relic race of *A. Bodini,* in which a few variational tendencies extend beyond the norm encountered in the main ranges of the species. Possibly these exaggerated characters have become fixed through geographic isolation, in which case *A. stragulus* might deserve recognition as a poorly marked variety. The diameter of the teacup in which Jones and Fernald together brewed up a classic storm (cf. Jones, Contrib. West. Bot. 15: 14; Rhodora 44: 437) has shrunk perceptibly with the passage of time.

The Bodin milk-vetch is a delicately pretty astragalus, sometimes resembling forms of *A. alpinus,* at others recalling the *Oroboidei* in habit and appearance. It differs technically from these in its sessile and deciduous pod devoid of the rudimentary hyaline septum. In the southern Rocky Mountains it is often associated with *A. leptaleus,* but is easily distinguished by its determinate root-crown, pink-purple (not white) flowers, and turgid or bladdery (even though small) ascending pod of almost transparent texture. The roots are said to be dug as a spring vegetable by the Alaskan Eskimos (near Rampart, *Gasser,* WS), and in Wyoming the foliage is reported to provide good forage (A. Nelson in Erythea 6: 53).

The early collections of *A. Bodini* date back many years before its description by Sheldon in 1894. It was first encountered by Nuttall on his transcontinental journey of 1834 (cf. *Phaca debilis* in Appendix I). Fremont collected it on the Sweetwater River east of South Pass in 1843 (K), and Geyer found it in "springy meadows of the upper Platte" (*Geyer 3,* G, K, NY, OXF, P) two years later. Capt. Pullen collected it on the Mackenzie River in 1850 (K), and another of his specimens, dated 1849, came ostensibly from "between Cape Barrow and the MacKenzie River" (K), but there is no modern collection from the arctic coast and the locality requires confirmation. The Torrey herbarium (NY) possesses old specimens of *A. Bodini,* one of them distributed by Hooker as *Phaca alpina,* another labeled "*Phaca elegans.* Plains of the Rocky Mountains," which must have been brought back by early travelers in the Canadian Northwest, the first of them possibly by Richardson. A plant mentioned by Jones (1923, p. 89), from Salubria, Idaho, as representing a form of *A. debilis* (= our *A. Bodini*) with obtuse leaflets has turned out to be *A. lentiginosus* (*Jones in April, 1900,* POM).

96. Astragalus polaris

Low, diffuse, slender and delicate, with the growth-habit and subterranean caudex of *A. alpinus,* thinly strigulose with straight, subappressed, white and often some (or mostly) black or fuscous hairs up to 0.2–0.3 mm. long, the herbage green, the leaflets glabrous above; *stems* buried for a space of 1.5–9 cm. (probably sometimes more), the aerial part weakly ascending, 2–11 cm. long, simple or spurred at the first emersed nodes, the aerial internodes very short, less than 1 cm. long, sometimes all concealed by imbricated stipules; *stipules* papery-membranous, pallid or purplish, 1.3–4 mm. long, triangular-ovate, amplexicaul and connate through half their length or more into a loose, bidentate sheath wider than the stem, glabrous or thinly ciliate; *leaves* 1–7 cm. long, with short, subfiliform petiole and 7–17 oblong, oblong-obovate, or obovate-cuneate, deeply retuse, mostly flat but marginally elevated or involute, commonly crowded leaflets (0.5) 1.5–5 mm. long, sometimes faintly reticulate-nerved beneath; *peduncles* very slender, 1.5–6.5 cm. long, decumbent in fruit; *racemes* very shortly but loosely 1–6-flowered, the flowers loosely spreading-ascending, the axis up to 13 mm. long, mostly less; *bracts* membranous, purplish, ovate, 0.7–2 mm. long, sometimes glandular-margined; *pedicels* slender, ascending or a little arched outward, at anthesis 1–2 mm., in fruit a trifle thickened and 1.5–2.7 mm. long; *bracteoles* 0, or a minute scale; *calyx* 4.6–7 mm. long, densely strigulose with black or black and white hairs, the subsymmetric disc 0.7–1.1 mm. deep, the campanulate, membranous and often purplish tube 3.3–4.6 mm. long, 2.2–3.2 mm. in diameter, the broadly subulate to triangular-subulate, obtuse or subobtuse teeth 0.9–2.5 mm. long, the whole becoming papery, ruptured, marcescent; *petals* lilac-purple; *banner* recurved through ± 45°, rhombic-elliptic or obovate-cuneate, deeply notched, 10–13.4 mm. long, 5–9 mm. wide; *wings* (1–2.7 mm. shorter) 8.6–10.7 mm. long, the claws 3.5–5 mm., the elliptic, oblanceolate, or oblong-obovate, erect or slightly incurved, obtuse or obliquely emarginate blades 5.5–6.8 mm. long, 1.9–3 mm. wide; *keel* 9–9.7 mm. long, the claws 4–4.5 mm., the lunately half-obovate blades 5–5.4 mm. long, 2.2–2.6 mm. wide, incurved through 85–95° to the broadly rounded apex; *anthers* 0.4–0.55 mm. long; *pod* loosely ascending (humistrate), sessile on the slightly produced receptacle or incipient gynophore up to 1 mm. long, lance- or broadly oblong-elliptic in profile, straight or very slightly incurved, strongly turgid or bladdery, 1.5–3.8 (4.2) cm. long, 4.5–12 (or when pressed apparently up to 15) mm. in diameter, somewhat laterally compressed but the faces ± strongly convex, the sutures filiform but both (especially in narrower pods) prominent, the papery-membranous, pale green, often red-tinged valves densely strigulose with black or fuscous and sometimes a few (rarely all) white hairs, not inflexed; *dehiscence* and seeds unknown.—Collections: (o); representative: *J. M. Macoun 33* (NY); *Scamman 6419* (GH); *Mexia 2073a* (CAS); *Viereck 1386* (COLO); *Galen Smith 2459* (ALA, UC); *G. H. Ward*

1275 (DS, GH, UC, US); *J. W. Hutchinson 678* (K); *Wetherell & Finzel 763* (CAS, COLO, NY, RM, RSA, US).

Arctic and subarctic shores, moraines, and in sandy or gravelly alluvial soil or shingle barrens along cold brooks and rivers, near sea level and up to 5000 feet in the interior, apparently local in Alaska: northwest and west coasts (Cape Sabine to Kotzebue Sound; Cape Vancouver; Alaska Peninsula), inland to both slopes of the Brooks Range (Utukok River and Walker Lake); also in the Alaska Range (McKinley Park).—Map No. 39.—Late June to August.

ASTRAGALUS POLARIS (of polar regions) Bth. ex Hook. in Trans. Linn. Soc. 23: 323. 1862. —"Hab. Eschscholtz Bay, in Kotzebue's Sound, *Seeman.*"—Holotypus, labeled "N.W. America, summer 1849, *Seeman 1910.*," K! phototypus, NY! isotypus, from "Eskimoland," BM!—*Oxytropis polaris* Seem., Narr. Voy. Herald 2: 21. 1853, nom. nud. *Tragacantha polaris* (Bth.) O. Kze., Rev. Gen. 947. 1891. *Phaca polaris* (Bth.) Rydb. in N. Amer. Fl. 24: 349. 1929.

Homalobus amblyodon (with blunt calyx-teeth) Rydb. in N. Amer. Fl. 24: 266. 1929.—"Type collected at Stepovak Bay, Alaska Peninsula, Alaska, July 8–19, *Charles Palache.*"—Holotypus, US! isotypus (fragm.), NY!—*Astragalus amblyodon* Kearney ex Rydb. l. c., in syn. *A. amblyodon* (Rydb.) Hult., Fl. Alaska & Yukon 1085. 1929.

Although discovered so long ago the polar milk-vetch remains rather poorly known, and truly ripe fruits showing the mode of dehiscence and the seeds are still lacking. The species is easily distinguished from the habitally similar and partly sympatric *A. Bodini* and *A. nutzotinensis* by its large, sometimes proportionately enormous, sessile and swollen pod and from the latter, at anthesis, by the smaller flower. In habit and stature it resembles *A. alpinus,* but the deeply retuse leaflets, strongly graduated petals, and sessile fruit provide differential characters at all seasons of growth. The pod of *A. polaris* varies a great deal in size and degree of inflation, but it seems impossible to separate the typical form with elongate, balloon-like fruits from *A. amblyodon,* described as having a smaller, compressed, and two-sided pod of the homaloboid type. The typus of *A. amblyodon* was collected when the fruit was only half grown, and its ultimate size and inflation cannot be demonstrated until riper material from Stepovak Bay becomes available. However this may turn out, there are examples, from McKinley Park, of an astragalus exactly matching *A. amblyodon* in growth-habit, flower, and especially in the short and broad calyx-teeth, which has a pod up to 3 cm. long and 8 mm. in diameter, decidedly inflated although with both sutures salient. The polar milk-vetch collected in the Brooks Range by Galen Smith (cited above) combines this same type of pod with the longer calyx-teeth of *A. polaris* as it is typically developed on the Arctic Coast. For the present I know the greatly swollen pod, up to 12 mm. in diameter, only from the type-locality in Eschscholtz Bay, from Point Hope, and from Cape Vancouver. But as there seems to be no other character correlated with the degree of the pod's inflation, it is reasonable to interpret *A. amblyodon* as a minor variant.

XXII. Sectio GYNOPHORARIA

Slender, caulescent, perennial, with subterranean caudex; *vesture* basifixed *stipules* connate; *leaves* imparipinnate, with 7–17 leaflets; *flowers* few (1–4), spreading, of moderate size, the banner 12–17 mm. long; *pedicels* persistent; *calyx-tube* broadly campanulate; *petals* purple, the wings and keel subequal, the keel-tip obtuse; *pod* ascending (humistrate), sessile but elevated on a long gynophore, disjointing when ripe, the body narrowly oblanceolate to linear-oblong in profile, lunately or annulately incurved, strongly compressed, bicarinate by the sutures, unilocular, the valves papery-membranous; *dehiscence* basal, apical, and finally through both sutures; *ovules* 14–25.—Sp. 1, mesophyte, of Yukon and Alaska.

ASTRAGALUUS sect. GYNOPHORARIA (Rydb.), stat. nov., based on *Gynophoraria* Rydb. in N. Amer. Fl. 24: 280. 1929.—Generitypus: *G. falcata* Rydb. = *Astragalus nutzotinensis* Rouss. *Astragalus* subgen. *Gynophoraria* (Rydb.) C. L. Porter in Amer. Jour. Bot. 27: 727. 1940.

In technical characters and general appearance the Nutzotin milk-vetch, the one species of sect. *Gynophoraria,* agrees with sect. *Polares,* from which it differs principally in the long stipelike gynophore. The compressed and crescentic or annular body of the pod is equally remarkable, though not structurally different from that of the *Polares.* When Rydberg described

Map No. 39. Canada and parts of United States. Range of ▼ *A. Bodini*; and of ♦ *A. polar*

et, top right, Alaska. Range of *A. nutzotinensis.*

Gynophoraria as a genus, he had seen only imperfect flowers, and he thought the wings and keel either very early deciduous or possibly abortive; but modern collections show the flower perfectly normal for *Astragalus*. In the case of *Gynophoraria*, Rydberg (l.c., and 1929[3], p. 199, Pl. XV L) distinguished between a genuine stipe and a stipelike gynophore. As shown elsewhere in the Atlas, a gynophore is not unique to *Gynophoraria* in the *Astragalanae;* it is a not infrequent modification of the receptacle, which has evolved separately in several lines of inheritance in *Astragalus* sens. lat.

97. Astragalus nutzotinensis

Low, weak and slender, diffuse or prostrate, with a taproot and loosely, sometimes repeatedly branching, subterranean caudex, thinly and rather loosely strigulose with appressed and narrowly ascending hairs up to 0.3–0.45 mm. long, the herbage green or greenish-cinereous when young, the leaflets glabrous or nearly so above, the inflorescence black-hairy; *stems* 6–15 cm. long, branched or spurred below the middle, the aerial either shorter or much longer than the buried part; *stipules* thinly herbaceous becoming papery and brownish, often purplish when young, much broader than the stem, amplexicaul and connate through half to nearly their whole length into a loose, 2-lobed sheath, the lowest ones glabrous, the upper ones strigulose dorsally; *leaves* 2–6.5 cm. long, with slender petioles and 7–15 (17) broadly oval, oval-ovate or -obovate, more rarely oblong-oblanceolate, obtuse or truncate, sometimes retuse, commonly rather distant leaflets (1) 2–8 mm. long, the ciliate margins elevated or a little inrolled; *peduncles* ascending, (2.5) 5–8 (10) cm. long, surpassing the leaf, reclinate in fruit; *racemes* loosely but very shortly (1) 2–4-flowered, the flowers spreading-ascending, the axis scarcely elongating, (0) 2–12 mm. long in fruit, often produced as a subulate appendage beyond the last flower; *bracts* membranous, purplish, ovate, broadly lanceolate, or lance-acuminate, 1.5–4.5 mm. long; *pedicels* ascending or a little arched outward, at anthesis 1.8–3.4 mm., in fruit a little thickened, 2–4 mm. long; *bracteoles* 0; *calyx* 6–6.7 mm. long, strigulose with black hairs, the subsymmetric disc 1–1.5 mm. deep, the submembranous, purplish tube 4–4.7 mm. long, 3.7–4.5 mm. in diameter, the subulate teeth 1.9–2.2 mm. long, separated by wide sinuses, the whole becoming papery, marcescent unruptured; *petals* pink- or reddish-purple; *banner* gently recurved through ± 30–45°, amply obovate-cuneate, openly notched, 12-17 mm. long, 9–12 mm. wide; *wings* 11.1–14.6 mm. long, the claws 4.3–6.2 mm., the broadly oblanceolate, obtuse or erose-emarginate, nearly straight blades 7.9–10.3 mm. long, (3) 3.6–5 mm. wide; *keel* (0.5 mm. longer to 1.6 mm. shorter than the wings) 11.2–13.7 mm. long, the claws 4.5–6.1 mm., the lunately half-elliptic blades 7.4–8.7 mm. long, 3.1–3.5 mm. wide, gently incurved through 50–90° to the obtuse apex; *anthers* 0.65–0.8 mm. long; *pod* ascending (humistrate), elevated on a slender, glabrous gynophore 5–10.5 mm. long, the body narrowly oblanceolate or linear-oblong in profile, incurved through one quarter to a whole circle, cuneately or acuminately tapering at base, abruptly deltoid and apiculate at apex, 3–4.5 (5) cm. long, 5–7.5 mm. in diameter, strongly compressed laterally and 2-sided, the faces at first nearly flat, low-convex at maturity, the slender sutures both salient, the thin, pale green, commonly purple-dotted or -suffused valves becoming papery-membranous and subdiaphanous, minutely black- or white-strigulose, not inflexed; *seeds* olivaceous or pale brown, smooth but dull, 2–2.5 mm. long.—Collections: 10 (o); representative: *Warren distrib. A. & R. Nelson 3539* (NY, RM, SMU); *Viereck 1087* (COLO); *Galen Smith 2167* (ALA); *Wetherell & Finzel 764, 766* (CAS, COLO, NY, RM, RSA, US); *Scamman 647* (GH); *O. Murie 51,173* (RM).

Silty shores and gravel bars of cold brooks and rivers and stony moraines at the foot of melting ice, about 3000–3200 feet, apparently uncommon, known only

from the Alaska Range (McKinley Park) east to the headwaters of the White and Don Jek Rivers in the Nutzotin Mountains, eastcentral Alaska and adjoining Yukon.—Map No. 39.—June to August.

ASTRAGALUS NUTZOTINENSIS (of the Nutzotin Mountains) Rouss. in Contrib. Lab. Bot. Univ. Montréal 24: 14. 1933, based on *Gynophoraria falcata* (sickle-shaped) Rydb. in N. Amer. Fl. 24: 280. 1929.—"Type collected between Lake Kluane and Don Jek River, Yukon, August 11–27, 1920, *August Muller* (type in herb. Acad. Nat. Sci. Phila.)."—Holotypus, collected by Adolf Müller, PH!—*A. falciferus* (sickle-bearing, of the pod) Hult. in Svensk. Bot. Tidsk. 30[8]: 526, fig. 1, c, d. 1936 (non *A. falcatus* Lamk., 1783). *A. Gynophoraria* (the generic name) Tidest. in Proc. Biol. Soc. Wash. 50: 20. 1937.

The Nutzotin milk-vetch, one of several slender and delicate creeping astragali found in the Alaskan tundra, is similar in general habit of growth to *A. alpinus* and the *Polares*. Flowering plants may be distinguished from the former by the mostly few (7–15, not 15 and more) leaflets, and by the fewer, slightly larger flowers; the *Polares* have flowers substantially smaller if as few and only 2–13 (not 14–25) ovules. The fruit of *A. nutzotinensis* is unique, being raised out of the calyx on a long stipelike gynophore instead of truly (and more shortly) stipitate as in *A. alpinus*, or sessile on a scarcely produced receptable as in sect. *Polares*. Moreover the body of the pod is at once greatly compressed laterally, and either falcately incurved or coiled into a complete ring. Relative to the size of the leaves and leaflets, the flowers of the Nutzotin milk-vetch are notably ample and showy. The species is one of the prettiest found in subarctic regions.

XXIII. Sectio JEJUNI

Dwarf, subacaulescent perennials, with superficial root-crown and closely forking caudex; *vesture* basifixed; *stipules* connate; *leaves* imparipinnate, with 9–17 small leaflets, the terminal one either jointed or decurrent; *flowers* few, loosely and shortly racemose, spreading, small, the banner 5–7.5 mm. long; *pedicels* subfiliform, disjointing; *calyx-tube* campanulate; *petals* pink-purple or ochroleucous, regularly graduated, the keel-tip strongly incurved, obtuse; *pod* spreading, sessile, deciduous when ripe, obliquely ovoid, obovoid, or subglobose, bladdery-inflated but rather small (± 1–1.7 cm. long), unilocular, the valves papery-membranous, mottled; *dehiscence* apical and through the length of both sutures, the valves ultimately separating; *ovules* 10–14.—Sp. 2, xerophytes, of southwestern Wyoming to eastcentral Nevada and southcentral Utah.

ASTRAGALUS sect. JEJUNI (Jones), comb. nov., based on *Astragalus* sect. *Inflati* subsect. *Jejuni* Jones, Rev. Astrag. 95, in clave. 1923.—Sp. typica: *A. jejunus* Wats.—*Phaca* subgen. *Chartocystis* sect. *Jejunae* (Jones) Rydb. in N. Amer. Fl. 24: 358. 1929.

The affinities of sect. *Jejuni* are far from clear. The typical species has traditionally been associated with others characterized by sessile, bladdery, unilocular fruits, although there is no individual species at all like it in other respects among Jones's *Inflati* or in Rydberg's *Phaca*. Its isolation in the genus has been recognized in the form of a section of the same name. In all details up to the disjointing fruit, and particularly in the form of flower and stipule, and in the xerophytic reduction of the herbage, *A. jejunus* is suggestive of several homaloboid groups, such as the *Cusickiani, Genistoidei,* or *Ervoidei*. However, in the *Ervoidei,* the deciduous, inflated pod of *A. microcystis* has almost certainly been recently derived from a flattened, persistent one otherwise characteristic of its section; and the highly modified sect. *Drabellae,* which is thought to have arisen from a common ancestry with the emmenoloboid *Genistoidei,* has achived a disjointing pod with no great change in its texture or mode of compression. I can find no hint of relationship to any group or member of a group in the piptoloboid series, and I have accordingly introduced the *Jejuni* at this place.

Key to the Species of Sect. Jejuni

1. Petioles early becoming stiff and rigid, persistent after fall of the readily disarticulating leaflets as a thatch on the caudex-branches; *terminal leaflet* continuous with the rachis; *petals* pink-purple with white wing-tips; s.-w. Wyoming, immediately adjoining Utah, and (isolated) e.-centr. Nevada ..... 98. *A. jejunus*
1. Petioles flaccid, persisting on the caudex-branches only as weak tatters; *terminal leaflet* jointed; *petals ochroleucous,* immaculate; s.-centr. Utah ..... 99. *A. limnocharis*

98. Astragalus jejunus

Dwarf, tufted, with a stout woody taproot and strongly developed, shortly forking, suffruticulose caudex, strigulose with straight or incumbent hairs up to 0.1–0.3 mm. long, the herbage cinereous or greenish; *stems* (or caudex-branches) very short, beset with a thatch of persistent stipules and rigid petioles, the growth of the year 0–2 cm. long, the internodes mostly concealed by imbricated stipules, rarely a few developed and up to 5 mm. long; *stipules* 1.5–2.5 mm. long, at first membranous and thinly pubescent dorsally, becoming papery and glabrescent, all amplexicaul and connate into a loose sheath, the uppermost with short, deltoid free blades; *leaves* erect, crowded on the young shoots, 1–4 cm. long, with 9–15 (17) linear or narrowly elliptic, obtuse or subacute, thick-textured leaflets 1–5 mm. long, all ascending along the stiff, grooved rachis, the lateral ones very shortly petiolulate, at length disjointing and leaving a pitted scar, the terminal one confluent; *peduncles* subfiliform, 1–3.5 cm. long, erect in flower, reclinate in fruit; *racemes* shortly but loosely 3–7-flowered, the flowers spreading, the axis scarcely elongating, not over 1 cm. long in fruit; *bracts* papery-membranous, ovate-acuminate, 1–1.5 mm. long; *pedicels* very slender, at anthesis about 1.5 mm., in fruit 1.5–2.5 mm. long; *bracteoles* 0; *calyx* 2.3–3 mm. long, strigulose with partly black or almost all white hairs, the subsymmetric disc 0.4–0.6 mm. deep, the campanulate tube 1.5–2 mm. long, 1.3–1.7 mm. in diameter, the subulate teeth 0.6–1 mm. long; *petals* pink- or lavender-purple, the wing-tips paler or white; *banner* recurved through ± 70°, obovate or suborbicular above the broadly cuneate claw, 5–6.5 mm. long, 4.5–5 mm. wide; *wings* 4.5–6 mm. long, the claws 1.3–2 mm., the lunately oblanceolate, obtuse, more or less incurved blades 4–4.6 long, 1.4–1.8 mm. wide; *keel* 3.7–4.4 mm. long, the claws 1.5–2 mm., the half-obovate blades 2.5–2.9 mm. long, 1.5–1.8 mm. wide, incurved through 115–125° to the deltoid, obscurely porrect apex; *anthers* 0.25–0.35 mm. long; *pod* spreading, sessile, obliquely obovate to subglobose, beakless or nearly so, bladdery-inflated, (8) 10–17 mm. long, 7–11 mm. in diameter, with slightly convex ventral and strongly convex dorsal sutures, the papery-membranous, brightly mottled, finely strigulose valves not at all inflexed; *ovules* 10–14; *seeds* greenish-brown, purple-speckled, smooth, 1.9–2.5 mm. long.—Collections: 17 (vi); representative: *E. & L. Payson 2586* (NY); *C. L. Porter 5010* (NY, SMU, TEX); *A. Nelson 2973* (NY); *Ripley & Barneby 7835* (CAS, GH, NY, RSA, UTC).

Arid, windswept summits of shale, sandstone, or cobblestone bluffs, bare clay ridges, sometimes in low sagebrush, 6000–7500 feet, local but forming colonies, Green River Basin north of the Uintah Mountains and valley of the Bear River, southwestern Wyoming and immediately adjoining Utah; isolated on calcareous clay knolls in the White Pine Mountains (north of Hamilton, White Pine County), eastcentral Nevada.—Map No. 40.—May to July.

Astragalus jejunus (starveling) Wats., Bot. King 73, Pl. 13, fig. 1–6. 1871—"...on the foothills of Bear River Valley, near Evanston, Utah [now Uinta County, Wyoming]... 279."—Holotypus, collected by Sereno Watson in August, 1869, US! isotypi, GH, NY!—*Tragacantha jejuna* (Wats.) O. Kze., Rev. Gen. 945. 1891. *Phaca jejuna* (Wats.) Rydb. in Bull. Torr. Club 40: 48. 1913.

The starveling milk-vetch, *A. jejunus,* is instantly recognized by its diminutive, tufted growth-habit, imbricated, sheathing stipules, stiff leaf-rachis beset with very small, upwardly directed leaflets (the terminal one decurrent), and small, purplish flowers succeeded by small, bladdery fruits of exceptionally delicate, diaphanous texture and, as a rule, gaily mottled with reddish-purple. The petioles persistent together with the leaf-rachis as a thatch on the caudex-branches form a protective collar around the young shoots. They are of the same structure as the "spines" of the Eurasian *Tragacanthae,* but although stiff and wiry they are not truly prickly. In Wyoming and immediately adjoining Utah, *A. jejunus* is distributed over a very natural

area centering around the Bear-Green River divide and is found commonly on shale or sandstone. The discovery of the species in Nevada, at a station lying distant some 250 miles southeast of the main range, seemed at first wholly mystifying. This type of dispersal becomes less enigmatic, however, if one considers *A. limnocharis* as forming part of the pattern. There are several species, e. g., *Tanacetum capitatum* T. & G., or vicariant pairs of related species found primarily on the high deserts of Wyoming, which reappear disjunctly in a specialized knoll environment (mostly on limestone) about the head of the Sevier in Utah; and others of bicentric dispersal in southern Utah and the calcareous highland of eastern Nevada. *Leptodactylon caespitosum* Nutt. is found in all three areas and must be regarded as a relic of a once more continuously dispersed flora. In Nevada *A. jejunus* is found on knolls of gravelly clay derived from weathered limestone, where it is associated with *Leptodactylon, Artemisia pygmaea* Gray, *Lepidium nanum* Wats. and *Oxytropis oreophila* Gray. There can be no question as to its spontaneous occurrence; and the material *(Ripley & Barneby 9934,* RSA) seems to differ in no feature of significance from the typical Wyoming form.

99. Astragalus limnocharis

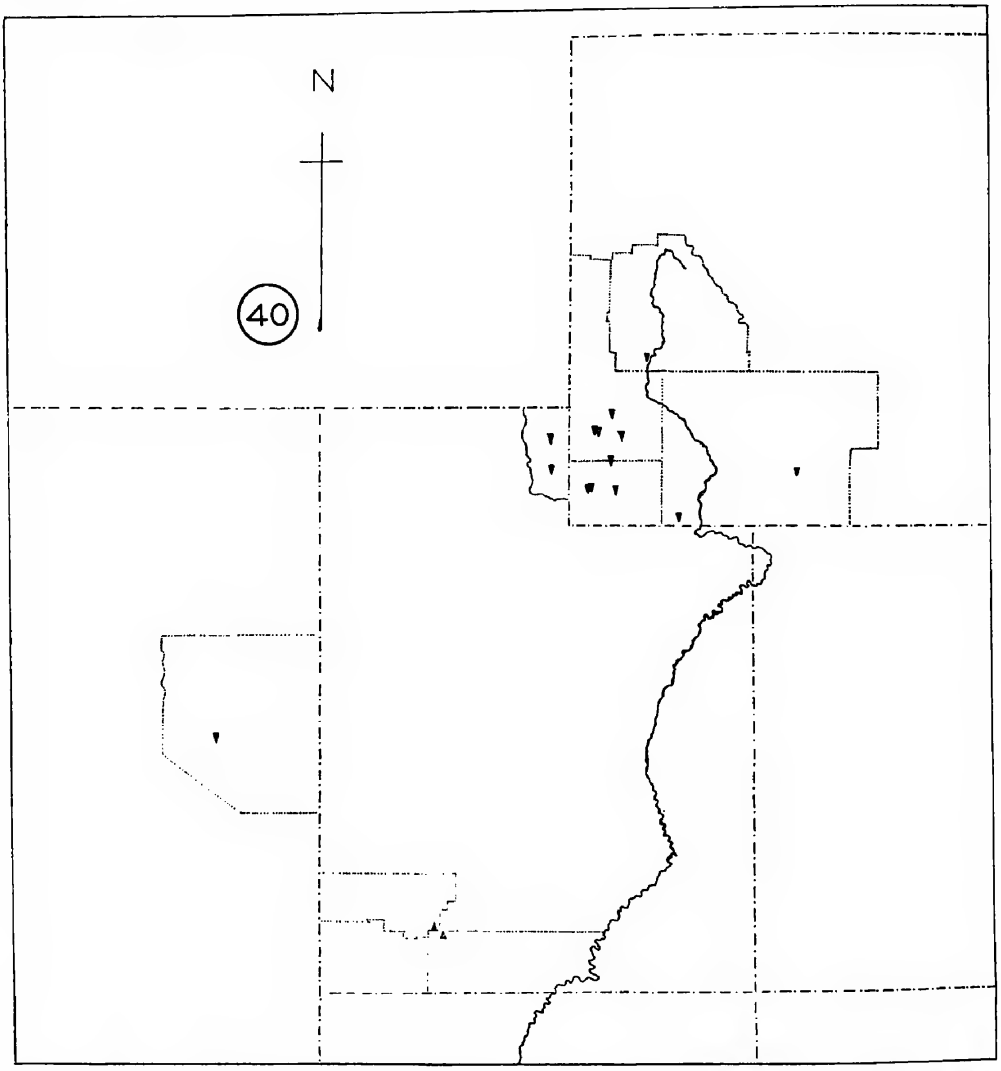
Dwarf, tufted, subacaulescent, with a taproot and ultimately a shortly forking caudex, strigulose with narrowly ascending, straight hairs up to 0.2–0.4 mm. long, the herbage cinereous or greenish, glabrous or nearly so above, the involute margins of the leaflets ciliate with hairs directed inward toward the midrib; *stems* of the year 1–3 cm. long, simple, clothed in loosely imbricated stipules; *stipules* 2–4 mm. long, at first thinly herbaceous, purple-tinged, thinly strigulose dorsally, ciliate, becoming chartaceous, castaneous, glabrate, all amplexicaul and connate through about half their length into a loose sheath, the uppermost ones with spreading blades; *leaves* crowded, erect, 2–4 cm. long, with slender, flexible petioles and 9–13 oblong-oblanceolate, obtuse, involute leaflets (1.5) 3–7 mm. long; *peduncles* erect and ascending, (1) 3–4 cm. long, reclinate in fruit; *racemes* loosely but shortly (2) 4–8-flowered, the flowers spreading, the axis about 0.5 cm. long in fruit; *bracts* lanceolate to narrowly ovate, 1–3 mm. long; pedicels at anthesis about 1 mm., in fruit 1.5 long; *bracteoles* 0; *calyx* 2.8–3 mm. long, strigulose with black and a few white hairs, the disc about 0.4 mm. deep, the campanulate tube 2 mm. long, 1.6 mm. in diameter, the subulate teeth 0.7–1 mm. long; *petals* ochroleucous, immaculate; *banner* recurved through ± 70°, obovate-cuneate, 6.5–7.5 mm. long, about 4 mm. broad; *wings* 6–7 mm. long, the claws 1.5 mm., the lunately oblong-oblanceolate, obtuse blades 4.6–6 mm. long, 1.5–1.7 mm. wide; *keel* 3.9–4.8 mm. long, the claws 1.9–2 mm., the half-obovate blades 2.1–3 mm. long, 1.4–2 mm. wide, abruptly incurved through 95–100° to the deltoid, obscurely porrect apex; *anthers* 0.3–0.35 mm. long; *pod* spreading, sessile, obliquely ovoid, bladdery-inflated, about 1.5 cm. long, rounded at base, contracted distally into a broad, shortly deltoid beak, a trifle sulcate ventrally, the sutures both filiform, the ventral one slightly, the dorsal strongly convex, the papery-membranous, translucent valves red-mottled on a pale green at length stramineous ground, strigulose with hairs 0.2–0.35 mm. long, not inflexed; *ovules* 10–12; *seeds* unknown.—Collections: 5 (i); representative: *Eastwood & Howell 7297,* in part (CAS); *Cottam 4253* (POM); *Degener & Peiler 16,401* (NY).

Open limestone gravel banks and lake shores in the timber belt, 8500–9500 feet, very local in the mountains about the Cedar Breaks in southeastern Iron and northwestern Kane Counties, Utah.—Map No. 40.—June to August.

Astragalus limnocharis (lake-beauty) Barneby in Leafl. West. Bot. 4: 236. 1946.—"Utah: ... gravelly beach of Navajo Lake, at Spruce Forest Camp, Iron Co., 13 July 1940, *Bassett Maguire No. 19474.*"—Holotypus, NY! isotypi, GH, RM, RSA, UTC!

The Cedar Breaks milk-vetch, *A. limnocharis,* closely resembles the preceding in all important characters, but differs in such a number of small ones as to assume a quite distinct appearance. As might be expected from its montane habitat, where the plants enjoy the protection of snowbanks during the winter months, *A. limnocharis* is a less extreme xerophyte

than *A. jejunus,* with leaves and stems comparatively weak and pliant, and petioles wholly deciduous or persistent only as fibrous tatters on the caudex-branches. In addition the ochroleucous flower is slightly longer, and the pod is contracted distally into a short but definite, laterally compressed beak, whereas that of *A. jejunus* is very obtuse at apex and merely tipped with an incurved style. This pretty little astragalus is locally plentiful at Navajo Lake; there it forms scattered colonies associated with *Arenaria filiorum* Maguire along the upper edge of the beach, well above the line of high water. It is known otherwise only from the Cedar Breaks, a few miles distant.



Map. No. 40. Utah and parts of Nevada and Wyoming. Range of ▼ *A. jejunus*; and of ▲ *A. limnocharis.*

XXIV. Sectio HUMISTRATI

Diffuse, prostrate, or matted, caulescent perennials, the stems arising from a knotty root-crown at soil-level or from a forking, suffruticulose caudex (rarely buried in sand or forest litter); *vesture* either basifixed or dolabriform; *stipules* all (or all but the uppermost) connate; *leaves* imparipinnate, with 5–19 leaflets; *racemes* few- or several-flowered, the flowers small or of moderate size, ascending at anthesis; *pedicels* not thickened, tardily deciduous; calyx-tube campanulate,

petals whitish, ochroleucous, or purple, regularly but not strongly graduated, the wings rarely a trifle longer than the banner, the keel-tip either porrectly acuminate or obtuse; *pod* ascending, rarely a trifle declined, commonly humistrate, deciduous, unilocular, dorsiventrally compressed at base or downward from the laterally compressed beak (obscurely so in *A. tegetarioides*), the valves thinly papery to leathery; *dehiscence* apical, through the gaping beak, after falling, in *A. tegetarioides* perhaps also basal; *ovules* 2–26.—Spp. 4, xerophytes, of Arizona and New Mexico, extending less abundantly into eastern Nevada, southern Utah, southwestern Colorado, trans-Pecos Texas, and northern Mexico; 1 very local in eastern Oregon.

The *Humistrati* form a compactly natural group, evidently related to sect. *Ervoidei,* and most nearly to the piptoloboid subsects. *Submonospermi* and *Microcystei,* from which they differ in the direction of the pod's compression. The most important member, for wide range and abundance of individuals, is *A. humistratus;* this is also the most generalized in organization, the most plastic morphologically, and the most adaptable to change in environment. It seems probable that *A. sesquiflorus,* traditionally associated with *A. humistratus,* is derived from it. As so often happens in *Astragalus,* a morphological change here goes hand in hand with specialization of the habitat. In both these species the vesture is dolabriform, the keel is triangular or porrect-acuminate at apex, and the ovules vary from six to twenty-six, but are rarely less than four pairs. The two other species, *A. micromerius* and *A. tegetarioides,* with their tiny flowers and fruits, basifixed vesture, and only two or four ovules, constitute a somewhat detached group distinguished further by a very strongly incurved and blunt keel-tip. The *Humistrati* are thus reasonably disposed in two subsections.

Key to the Subsections of Sect. Humistrati

1. Pubescence dolabriform; *ovules* 6–26 ..... XXIV (i). Subsect. *Humistrati*
1. Pubescence basifixed; *ovules* 2–4 ..... XXIV (ii). Subsect. *Micromerii*

XXIV (i). Subsectio Humistrati

Keel-tip triangular or porrect-acuminate; otherwise as given in the key to subsections.—Spp. 2, with range of the section except eastern Oregon.

Astragalus sect. Humistrati (Jones), stat. nov., based on *Astragalus* sect. *Homalobi* subsect. *Humistrati* Jones, Rev. Astrag. 68, in clave. 1923.—*Batidophaca* sect. *Humistratae* (Jones) Rydb. in N. Amer. Fl. 24: 315. 1929—Sp. typica: *A. humistratus* Gray.

Batidophaca sect. *Sesquiflorae* Rydb. in N. Amer. Fl. 24: 318. 1929—Sp. typica: *Batidophaca sequiflora* (Wats.) Rydb.=*A. sesquiflorus* Wats.

Key to the Species of Subsect. Humistrati

1. Racemes 3—many-flowered, if less than 5-flowered the *petals* ochroleucous; *leaflets* mostly 11–17 (fewer in some early or lower leaves); widespread and common ..... 100. *A. humistratus*
1. Racemes 1—3-flowered; *petals* purple; *leaflets* 7–11; rare and only in s. Utah and adjoining Arizona ..... 101. *A. sesquiflorus*

100. Astragalus humistratus

Prostrate, diffuse, or weakly assurgent, sometimes matted, the several or many stems radiating from the root-crown or caudex, slender and wiry or rather coarse, (0.4) 1.7–6 (8) dm. long, freely branched below the middle, more shortly branched or spurred at most nodes up to first peduncle, variably pubescent in kind and degree, the herbage silvery, cinereous, or green, the leaflets either glabrous or pubescent above; *stipules* submembranous becoming scarious, pallid or brownish in age, 1.6–10 (12) mm. long, pubescent dorsally, all fully amplexicaul and connate, the smaller lowest ones into a subtruncate or bidentate sheath, the upper progressively longer ones with narrowly triangular or lance-acuminate free blades as long as or longer than the sheathing base; *leaves* 1–6 (7.5) cm. long, all subsessile or the lowest shortly petioled, with (5) 9–17 (19) elliptic, oblong-elliptic, or oblanceolate, acute, or obtuse and mucronulate, or (in some lower leaves) obovate and

obtuse, flat, loosely folded, or involute, crowded or well-spaced leaflets (2) 3–17 (19) mm. long; *peduncles* divaricate or incurved-ascending, 1–9 cm. long, mostly as long as or longer, rarely shorter than the leaf; *racemes* at early anthesis rather closely 3–30-flowered, becoming looser, the axis more or less elongating, 0.5–9 (13) cm. long in fruit; *bracts* submembranous becoming scarious, narrowly ovate to lance-acuminate, 1.5–7 mm. long; *pedicels* ascending or a trifle arched outward, at anthesis 0.4–1.4 mm., in fruit 0.5–2.2 mm. long; *bracteoles* 0–2, commonly present but often minute; *calyx* 3.2–7.6 (8.8) mm. long, pubescent like the herbage with white or sometimes a few black or fuscous hairs, the disc subsymmetric, the subulate or subulate-sectaceous teeth slightly shorter to much longer than the campanulate tube; *petals* varying from greenish- or pinkish-white to ochroleucous and to lurid or magenta-purple, regularly graduated, or the wings sometimes a trifle longer than the banner; *banner* abruptly recurved through 50–85°, variable in outline, 5.9–11.8 mm. long, carinate dorsally by the midnerve which often runs out as a minute appendage in the apical sinuses; *wings* 5.8–10.7 mm. long, the blades oblanceolate, elliptic, or obliquely obovate, obtuse or obscurely emarginate, both incurved but the left one more abruptly so and its inner margin folded over or toward the keel; *keel* 5.1–10 mm. long, the obliquely triangular blades abruptly incurved through 90–100° to the sharply deltoid to lance-acuminate and beaklike, often slightly porrect apex; *anthers* 0.4–0.75 mm. long; *pod* ascending, spreading, rarely a little declined, commonly humistrate, varying from plumply half-ovoid to narrowly oblong-ellipsoid, variably compressed, either rounded or sulcate dorsally, 6–20 mm. long, contracted distally into a deltoid or triangular-acuminate, laterally compressed beak, the thinly fleshy, strigulose or subvillosulous valves becoming leathery or papery, stramineous or brownish, reticulate or nearly smooth, not inflexed; *ovules* 6–26; *seeds* dark brown to nearly black, smooth or pitted, sublustrous, 1.7–2.8 mm. long.

The various forms of the polymorphic ground-cover milk-vetch, *A. humistratus,* fall readily into two main categories or subspecific branches. Disregarding for the moment the very distinct var. *crispulus,* it is possible to trace a well-defined dichotomy within the species composed of a southeastern branch, which is characterized by relatively long and narrow, pluriovulate pods, and a northwestern one, which is characterized by shorter pods, plumper in profile and relatively few-ovulate. Apart over most of their ranges of dispersal, the forks of the dichotomy are sympatric in some areas of eastcentral and western New Mexico. Within each branch there are parallel variations in the dispersal and density of the vesture, and in each are found a more glabrous and a more pubescent variety which occupy clearly different, although partly overlapping ranges. Varieties based on characters of vesture alone are seldom satisfactory in *Astragalus,* but in *A. humistratus,* even though two forms may be found in close proximity, they are not known as yet to intergrade. In the past most authors, always excepting Rydberg, have united all the silvery forms of *A. humistratus* under the name of var. *sonorae,* whatever the pod's shape or length; but they illogically maintained glabrescent vars. *Hosackiae* and *humistratus* because of precisely equivalent differences in the fruit. Two more rather striking modifications have occurred in the species: one (our var. *tenerrimus)* involving reduction in size of all organs; the other, an alteration in the quality of vesture from a stiff and closely appressed type of hair to a weak and sinuous one, which gives var. *crispulus* its immediately striking individuality. The species as a whole is set off from all relatives by well-defined boundaries and is easily recognized by the combination of the hair-attachment, connate stipules of thin texture, shallow calyx-tube, and unilocular pod formed on a small scale like that of the commoner species of *Argophylli,* that is, more or less obcompressed in the body and laterally flattened in the beak.

Key to the Varieties of A. humistratus

1. Pod (10) 13–20 mm. long, 3.1–6.5 mm. in diameter, 3–4 times longer than wide, dorsally sulcate its whole length up to the base of the beak; *ovules* (16) 18–26; s.-w. Colorado to s.-e. Arizona, extreme w. Texas, and n. Mexico (2)
2. Herbage thinly pubescent, green, the leaflets glabrous or nearly so above; relatively eastern in range ..... 100 a. var. *humistratus*

2. Herbage silvery-canescent or cinereous, the leaflets equally pubescent on both sides; relatively western in range ..... 100b. var. *sonorae*

1. Pod 6–14 mm. long, 2.5–5.7 mm. in diameter, 1½–2½ times longer than wide (in var. *crispulus* narrower, but then less than 1 cm. long), sulcate dorsally from the middle downward or esulcate; *ovules* 6–16; e.-centr. Arizona and adjoining New Mexico to Nevada and s. Utah (3)

3. Vesture of the herbage and stems composed wholly or nearly so of straight hairs, only some shorter ones sometimes crispate or sinuous; *banner* broadly obovate-cuneate to suborbicular, 5–8.5 mm. wide; *pod* mostly 3–5.5 mm. in diameter; either the *ovules* 9–16, or *leaflets* glabrous above (4)

4. Racemes (or at least some more vigorous ones) 7–20-flowered; *leaflets* 3–17 mm. long, some of them nearly always over 6.5 mm. long; widespread (5)

5. Herbage cinereous or silvery, the leaflets equally pubescent on both sides; w. New Mexico to Nevada and Utah, common ..... 100c. var. *humivagans*

5. Herbage green, the leaflets glabrous above; centr. Arizona, local ..... 100d. var. *Hosackiae*

4. Racemes 3–6 (8)-flowered; leaflets 2–6.5 mm. long; very slender, densely matted plants of the Kaibab Plateau at about 7900–9000 ft., n. Arizona ..... 100e. var. *tenerrimus*

3. Vesture composed largely or wholly of extremely fine, weak, sinuous or curly hairs; *banner* oblanceolate or narrowly obovate-cuneate, (3) 4–5 mm. wide; *pod* 2.5–3 mm. in diameter; *ovules* 6–9; *leaflets* pubescent above; local in the White Mountains of n.-e. Arizona and adjoining New Mexico ..... 100f. var. *crispulus*

100a. ASTRAGALUS HUMISTRATUS var. HUMISTRATUS

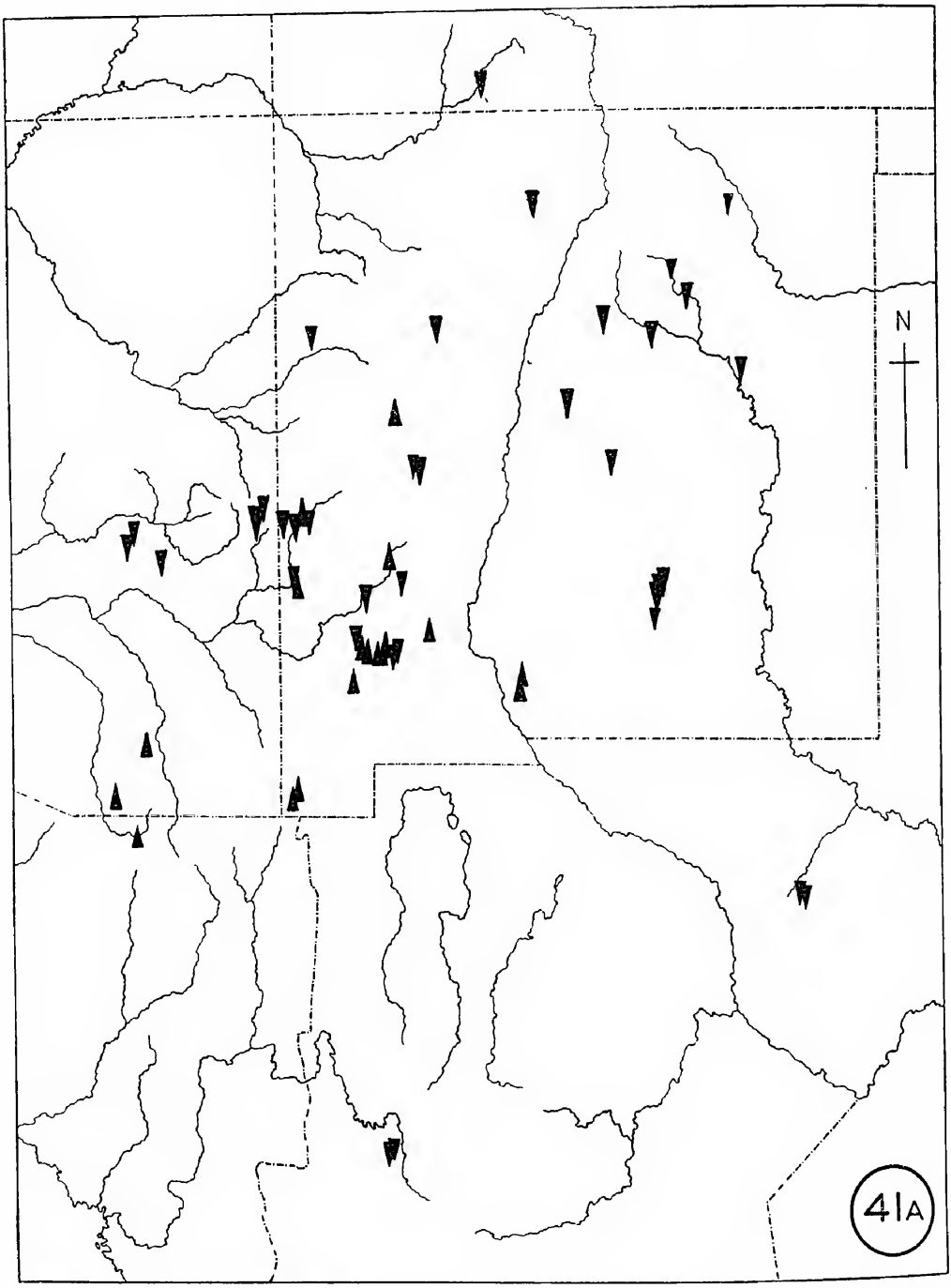
Herbage deep green or sometimes greenish-cinereous, thinly pilose-pilosulous with shorter, appressed, together with some longer, narrowly ascending hairs up to 0.8–1.5 mm. long, the leaflets glabrous above; *stems* prostrate, (1.5) 2–6 dm. long; *stipules* 2–9 (11) mm. long; *leaves* (1) 1.5–5.5 cm. long, often shorter than the internodes, with 11–17 leaflets 4–14 mm. long; *peduncles* (2) 3–8 cm. long; *racemes* (5) 7–30-flowered, the axis (1) 1.5–6 cm. long in fruit; *calyx* (5.8) 6–7.6 mm. long, the disc 0.7–1 mm. deep, the tube 3–3.8 mm. long, 2.7–3.4 mm. in diameter, the lance-acuminate or filiform-setaceous teeth (2.5) 3–4.5 mm. long; *petals* greenish-white or sordidly ochroleucous, often distally suffused and veined with dull purple; *banner* 9.5–11.8 mm. long, the broadly obovate to rhombic-ovate or subquadrate blade 6–8 mm. wide; *wings* 8.7–10.7 mm. long, the claws 3.1–4.5 mm., the blades 6.2–7.4 mm. long, 2.2–3.1 mm. wide; *keel* 7.8–10 mm. long, the claws (2.9) 3.2–4.5 mm., the blades 4.6–6.4 mm. long, 2.4–2.8 mm. wide, incurved through about 90° to the sharply triangular, somewhat porrect apex; *anthers* 0.45–0.55 mm. long; *pod* obliquely oblong- or lance-ellipsoid, gently incurved, 14–18 mm. long, 4–6.5 mm. in diameter, dorsally sulcate downward from the base of the beak, thinly (rarely densely) strigulose; *ovules* (16) 18–26.—Collections: 30 (vii); representative: *Metcalfe 453* (NY, NMC), *1067* (CAS, NY, NMC); *Ripley & Barneby 5078* (CAS, RSA); *Barneby 12,847* (CAS, RSA); *Bethel, Willey & Clokey 4172* (NY); *Warnock & Hinckley 7393* (SMU, SRSC, TEX); *Mexia 2573* (CAS).

Gravelly and sandy flats, open banks, sometimes on gravel bars of intermittent streams, commonly in pine forest, but descending to dry hills and mesas among piñon and juniper, chiefly on granites and basalt, 4400–8700 feet, widespread over northcentral New Mexico from the upper Canadian and Pecos to the sources of the Gila River, west into the White Mountains and Natanes Plateau in eastcentral Arizona, north just into southern Archuleta County, Colorado, and south interruptedly to the Davis Mountains in trans-Pecos Texas and into northwestern Chihuahua.—Map No. 41A.—May to September, but most abundant after summer rains.

ASTRAGALUS HUMISTRATUS (stretched out on the ground) Gray, Pl. Wright. 2: 43. 1853.—"Pebbly bed of a stream and on hills under pine-trees, near the copper mines, New Mexico;

Aug. (1003)."—Holotypus *(Wright 1003)*, collected in 1851, GH! isotypi, BM, K, NY, P, PH, US!—*Tragacantha humistrata* (Gray) O. Kze., Rev. Gen. 945. 1891. *Tium humistratum* (Gray) Rydb. in Bull. Torr. Club 32: 660. 1905 *("huministratum"). Batidophaca humistrata* (Gray) Rydb. in N. Amer. Fl. 24: 315. 1929.

Pisophaca datilensis (of Datil, New Mexico) Rydb. in N. Amer. Fl. 24: 328. 1929—"Type collected at Negrito Ranger Station, Datil Forest, New Mexico, September 22, 1919, *Eggleston*



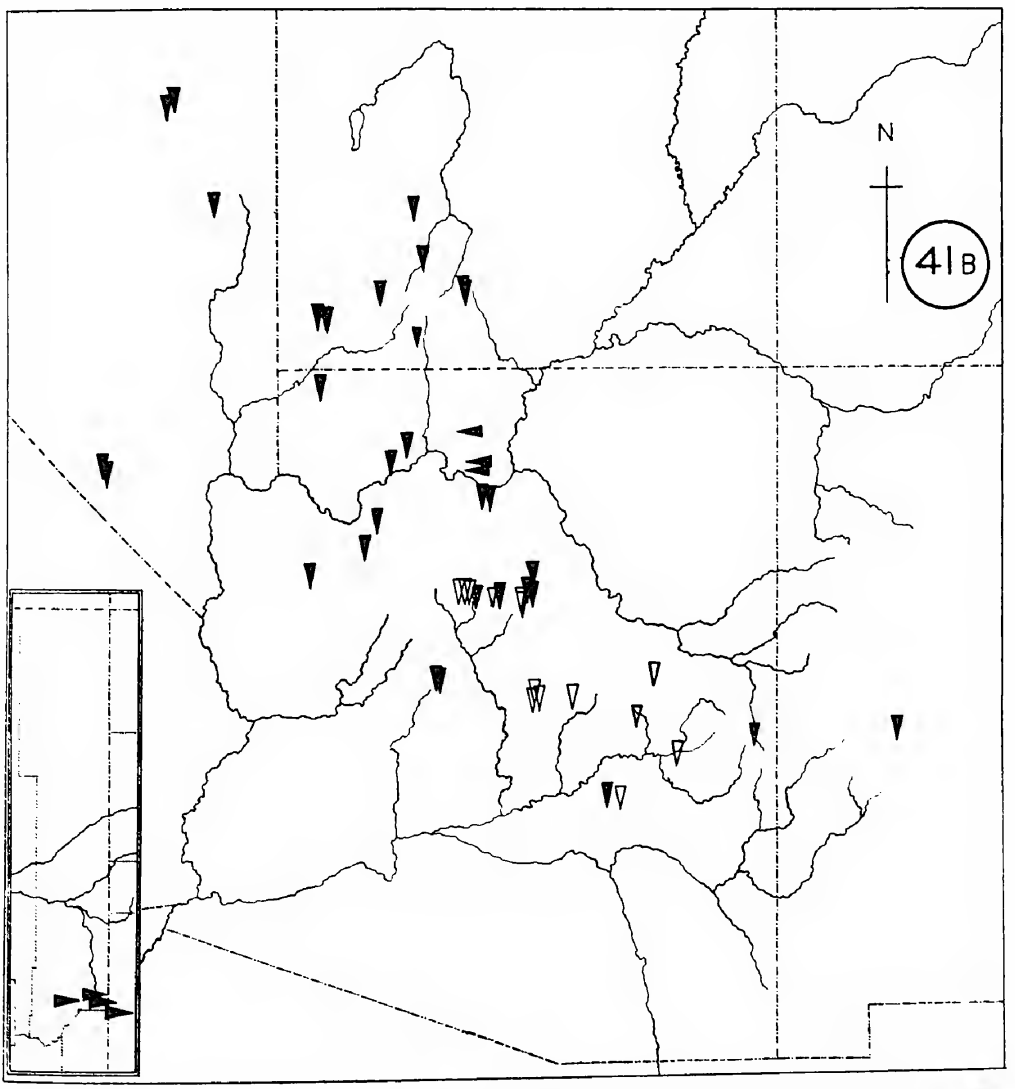
Map No. 41A. New Mexico and parts of adjoining states. Range (in part) of *A. humistratus*: ▼ var. *humistratus*; and ▲ var. *sonorae*.

16087."—Holotypus, NY!—*Astragalus datilensis* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. **50**: 21. 1937.

The ground-cover milk-vetch, var. *humistratus*, is a weedy and undistinguished astragalus which forms matted growths in dry pine forest or in open spaces among piñons and junipers; it quickly colonizes disturbed ground along highways and serves to control erosion of roadside banks and cuttings. The flowers vary from greenish-white to purple, but the cyanic pigment is usually diluted with brown or yellow and therefore lurid, only rarely of amethystine hue. The plant described as *Pisophaca datilensis* is a characteristic specimen of var. *humistratus* and has nothing in common with the forms of *A. (Scytocarpi) flexuosus* among which it originally appeared.

100b. Astragalus humistratus var. sonorae

Closely resembling var. *humistratus*, but the herbage densely strigose-pilose and strigulose, cinereous or silvery, the longest, often rather loosely ascending hairs up to 1–1.5 mm. long; *stems* (5) 10–35 cm. long; *stipules* 3.5–10 mm. long;



Map No. 41B. Arizona and parts of adjoining states. Range (in part) of *A. humistratus*: ◀ var. *humivagens*; ◁ var. *Hosackiae*; ◖ var. *tenerrimus*; and (inset) Apache County, Arizona, range of ◗ var. *crispulus*.

leaves (1.5) 2.5–5.5 cm. long, with (5) 9–17 leaflets 3–13 (15) mm. long; *peduncles* 3–8 cm. long; *racemes* 10–26-flowered, the axis 1.5–5.5 cm. long in fruit; *calyx* 4.6–6.8 (8) mm. long, the disc 0.6–1.1 mm. deep, the tube 2.5–3.5 mm. long, 2.5–3.1 (3.7) mm. in diameter, the teeth 2–4 (4.5) mm. long; *petals* dull purplish, amethyst-purple, or the banner alone purple-margined and -striate; *banner* 8.3–10.3 (11.4) long, 6–9 mm. wide; *wings* 8.4–10 (10.7) mm. long, the claws 2.4–3.4 mm., the blades 6–7.7 (8.2) mm. long, (1.8) 2.2–3.3 mm. wide; *keel* 7.3–8.8 (9.2) mm. long, the claws 2.4–3.5 mm., the blades 5.1–6 (6.5) mm. long, 2.4–3 mm. wide, abruptly incurved into a narrowly lance-triangular, porrect, beaklike apex; *anthers* 0.5–0.75 mm. long; *pod* lunately linear-oblong or narrowly oblanceolate in profile, (1) 1.3–2 cm. long, 3.2–4.1 mm. in diameter, (3) 4–5 times longer than wide, triquetrously compressed and dorsally grooved in the lower three-fourths (rarely the lower half), passing distally into the laterally compressed, lance-acuminate beak, the valves densely strigulose; *ovules* (16) 18–26.—Collections: 24 (iii); representative: *Metcalfe 1555* (CAS, NMC); *Eggleston 19,969* (NY); *Eastwood 8249* (CAS); *Barneby 11,176* (CAS, NY, RSA); *Wooton 4903* (NMC); *A. & R. Nelson 1578* (US).

Dry gravelly and sandy hillsides, washes, and canyon floors, often among junipers but ascending into the lower edge of the yellow pine forest and coming out into yucca-grassland in the foothills, 4500–6600 feet, locally plentiful in southwestern New Mexico, southeastern Arizona, and northern Sonora, extending east across the Divide to the Rio Grande and Rio San Jose Valleys in westcentral and southcentral New Mexico.—Map No. 41A.—Late March to September, apparently most abundant in the spring months, but flowering a second time after summer rain.

ASTRAGALUS HUMISTRATUS var. SONORAE (Gray) Jones, Contrib. West. Bot. **10**: 58. 1902, based on *A. sonorae* (of Sonora) Gray, Pl. Wright. 2: 44. 1853 *("Sonorae")*.—"Mountain valleys, between the San Pedro and the Sonoita, Sonora, Sept. (1005)."—Holotypus *(Wright 1005)*, collected in 1851, GH! isotypi, K, NY, PH, US!—*Tragacantha sonorae* (Gray) O. Kze., Rev. Gen. 948. 1891. *Batidophaca sonorae* (Gray) Rydb. in N. Amer. Fl. **24**: 317. 1929.

Batidophaca stipulacea (with large stipules) Rydb. in N. Amer. Fl. **24**: 316. 1929—"Type collected at Mangas [err. "Mangos"] Springs, Grant County, New Mexico, April 12, 1903, *Metcalfe* 60 . . . "—Holotypus, NY! istoypi MINN, ND, NMC, US!

The Sonoran ground-cover milk-vetch is essentially like var. *humistratus* in every way except for the more densely ashen or silky-pubescent foliage. It would surely rank as no more than a minor variant associated with relatively low elevations and a primarily vernal season of bloom, unless its range were perceptibly different. The type-collection of *A. sonorae* is unusual in the variety as described above because of its short pod, about 1 centimeter long and about 16-ovulate, although it is of the characteristic slender outline. No modern collections from Sonora have been examined, and some doubt remains as to whether Wright happened on a small-fruiting, perhaps depauperate colony or whether his plants represent a local minor variant intergradient to the next. The ground-cover milk-vetch of southeastern Arizona is unquestionably the same as that of southwestern New Mexico, which Rydberg described as *B. stipulacea*, and both are presumably of the same entity as that found across the border immediately to the south.

100c. ASTRAGALUS HUMISTRATUS var. HUMIVAGANS

Densely strigulose and appressed-pilose or -pilosulous throughout, the hairs straight or nearly so and up to 0.8–1.4 (1.7) mm. long (the longest sometimes narrowly ascending or exceptionally spreading, the shortest rarely sinuous-crispate), the herbage cinereous, canescent, or silvery-silky; *stems* (0.6) 1–6 (8) dm. long; *stipules* (1.5) 2–9 mm. long; *leaves* (1) 1.5–6 (7.5) cm. long, the (7) 11–17 (19) leaflets (2) 5–17 (19) mm. long; *peduncles* 2–9 cm. long; *racemes* (3) 7–22-flowered, the axis 1–9 (13) cm. long in fruit; *calyx* (4.5) 5–7.4 (8.8) mm. long, the disc 0.6–1.2 mm. deep, the tube (2.4) 2.7–3.7 (4.1) mm. long, 2.1–3.2 (3.5) mm. in diameter, the teeth (1.4) 1.9–3.6 (5) mm. long; *petals*

greenish-white or ochroleucous, commonly lined, suffused, or distally margined with dull purple, rarely all bright purple; *banner* 7.2–10.2 (11.6) mm. long, (5) 5.5–8.4 (9) mm. wide; *wings* (6.8) 7.4–9.5 (10) mm. long, the claws (2.2) 2.4–3.6 mm., the blades (4.4) 5–6.5 (7.1) mm. long, (1.5) 1.8–2.8 mm. wide; *keel* (6) 6.4–8.5 (9.1) mm. long, the claws 2.4–3.5 (3.8) mm., the blades (3.8) 4–5.6 (6) mm. long, 2.2–2.7 (3) mm. wide, the apex narrowly triangular or lanceolate and beaklike; *anthers* (0.4) 0.45–0.65 (0.7) mm. long; *pod* obliquely ovoid, obovoid, half-ovoid, or oblong-ellipsoid, (6) 8–14 mm. long, (3) 3.5–5.7 mm. in diameter, somewhat obcompressed in the lower half or third, either lunately incurved or straight below the deltoid or lance-acuminate, incurved beak, dorsally flattened or sulcate at base or from base to middle, the ventral suture acute and prominent, the valves thinly to quite densely strigulose with straight and appressed, or with incumbent and somewhat twisted hairs; *ovules* 10–16.—Collections: 32 (xi); representative: *Clokey 8408* (NY, RSA); *Jones 5204* (NY, POM); *Eastwood & Howell 7205* (CAS); *Ripley & Barneby 8462* (CAS, RSA); *M. & G. Ownbey 3005* (RSA, WS); *Barneby 12,635* (CAS, RSA), *12,911* (CAS, NY, RSA).

Dry gravelly or sandy slopes and flats, chiefly with juniper and piñon but ascending southward into yellow pine forest, strongly calciphile north and west of the Colorado River but elsewhere occurring mostly on basalt or other rock, (4450) 4900–8000 feet, widespread and locally plentiful in northwestern Arizona and southwestern Utah, extending less commonly northwest into eastcentral and southern Nevada and southeast to the Little Colorado-Gila-Rio Grande watershed in eastcentral Arizona and adjoining New Mexico.—Map No. 41B.—May to September, but much more abundant in spring than after summer rains.

ASTRAGALUS HUMISTRATUS var. HUMIVAGANS (Rydb.) Barneby in Amer. Midl. Nat. 55: 478. 1956, based on *Batidophaca humivagans* (spreading on the ground) Rydb. in N. Amer. Fl. 24: 316. 1929.—"Type collected at Mokiak Pass, Arizona, in 1877, *Palmer 108* . . ."—Holotypus, GH! isotypi, NY, US!—*A. humistratus* var., Gray in Proc. Amer. Acad. 13: 369. 1878.

Westward and northward from the Grand Canyon, var. *humivagans* is the only representative of the ground-cover milk-vetch and is found almost exclusively on limestone in the piñon belt. In central Arizona it is sympatric with var. *Hosackiae,* which has similar pods but green foliage. Southeastward along the Mogollon Escarpment, in soils mostly of volcanic origin, it overlaps the range of vars. *humistratus* and *crispulus,* although it is ordinarily found at lower elevations than either of the latter. At anthesis it resembles var. *sonorae* very closely, but a count of the few ovules will presage a characteristically short pod; the two silvery varieties, however, are not known to occur in the same area. The var. *humivagans* varies greatly in stature. A form with exceptionally large flowers occurs on Kanab Plateau and near Mount Trumbull in Mohave County, Arizona (*Peebles & Parker 14,730; McClintock 52–486,* both CAS), and a *gigas* phase, in which large flowers are combined with greatly elongated calyx-teeth, was found growing with typical plants in the White Mountains (*Barneby 5047* (gigas), *5048* (normal), both RSA). The pod varies from green to purplish or reddish when fresh, or is sometimes brightly mottled.

100d. ASTRAGALUS HUMISTRATUS var. HOSACKIAE

Thinly strigulose with relatively short, appressed hairs, or pilose-pilosulous wholly or in part with longer, narrowly ascending ones, the longest up to 0.6–1.2 mm. long, the herbage dark green or greenish-cinereous; *stems* (4) 7–36 cm. long; *stipules* (1.5) 2.5–8 mm. long; *leaves* (1) 1.5–5 cm. long, with 9–15 leaflets 3–10 (12) mm. long; *peduncles* 2–6 cm. long; *racemes* 8–20-flowered, the axis (0.8) 1.2–3.5 cm. long in fruit; *calyx* (3.8) 4–5.5 mm. long, the disc 0.6–0.9 mm. deep, the tube 2.5–3.2 mm. long, 2–2.8 mm. in diameter, the teeth (1) 1.4–2.5 mm. long; *petals* greenish-white or distally suffused with dull purple,

rarely all violet- or magenta-purple except the whitish wing-tips; *banner* 6.4–8 mm. long, 5–7 mm. wide; *wings* 6–7.4 mm. long, the claws 2.1–2.9 mm., the blades 3.8–5.4 mm. long, 1.9–2.5 mm. wide; *keel* 5.3–6.5 mm. long, the claws 2.2–3.1 mm., the blades 3.2–4.3 mm. long, 1.8–2.2 mm. wide, the apex triangular, not beaklike; *anthers* 0.4–0.55 mm. long; *pod* plumply half-ovoid or obliquely ovoid, 7–10 mm. long, (3.6) 4–5.5 mm. in diameter, a little less than 2–2½ times longer than broad, scarcely compressed except in the laterally flattened, cuneiform and cuspidate beak, the ventral suture straight or a little arched either way, the dorsal one strongly convex, not sulcate or at the base only, the valves finely strigulose; *ovules* (7) 8–14.—Collections: 22 (iii); representative: *Kearney & Peebles 13,979* (NY); *Eastwood 5911* (CAS), *17,212* (CAS, NY); *A. Nelson 1995* (RM, WS); *Barneby 12,651* (CAS, RSA); *Goodman & Hitchcock 1285* (CAS).

Dry banks and open flats in yellow pine forest, descending into openings of mixed pine-oak forest or oak-chaparral, chiefly on volcanic bedrock, locally plentiful along and near the crest of the Mogollon Escarpment in southern Coconino, southern Navajo, Gila, and Graham Counties, Arizona.—Map No. 41B.—May to September, either in spring or after summer rain.

ASTRAGALUS HUMISTRATUS var. HOSACKIAE (Greene) Jones, Contrib. West. Bot. 10: 58. 1902, based on *A. Hosackiae* (resembling some species of *Hosackia* or *Lotus*) Greene in Bull. Calif. Acad. Sci. 1: 157. 1885.—"Northern Arizona, 1883, Dr. Rusby."—Holotypus, collected near Flagstaff, Coconino County, CAS! isotypi, ND (dated "1882"), NY, OB, US *("No. 579")*! *Batidophaca Hosackiae* (Greene) Rydb. in N. Amer. Fl. 24: 316. 1929.

The var. *Hosackiae* closely resembles some forms of var. *humivagans* in everything except the glabrescent foliage. It is much less widely dispersed and less variable, the flowers always being relatively small and the pod always short and plump. In northern Gila County and on the Flagstaff Plateau the two varieties are almost equally common and are found in identical environments, but no intermediate populations have been seen.

100e. ASTRAGALUS HUMISTRATUS var. TENERRIMUS

Strigulose (strigose) with appressed or subappressed, largely or wholly straight hairs up to 0.6–0.95 (1.1) mm. long, the herbage greenish-cinereous or silvery, the leaflets pubescent or sometimes medially glabrescent above; *stems* slender, freely branched, forming loosely or densely woven mats up to 3 dm. (*fide* Jones up to 3 feet) in diameter; *stipules* 1.5–4.5 (5.5) mm. long; *leaves* 1–3 cm. long, with (9) 11–15 oval-oblanceolate or elliptic, or (especially in some lower leaves) broadly ovate or obovate, obtuse, subacute, or acute, flat or loosely folded leaflets 2–6.5 mm. long; *peduncles* very slender, 1–3 (4) cm. long; *racemes* 3–6 (8)-flowered, the axis 0.5–2 cm. long in fruit; *calyx* 3.2–4.7 mm. long, the disc 0.6–0.9 mm. deep, the tube 2.1–2.7 mm. long, 1.7–2.4 mm. in diameter, the teeth 1–2.2 mm. long; *petals* whitish, veined and sometimes distally suffused with sordid lilac-purple; *banner* 5.9–7.2 mm. long, 5.2–6.6 mm. wide; *wings* 5.8–6.6 mm. long, the claws 1.8–2.3 mm., the blades 4–5 mm. long, (1.4) 2–2.5 mm. wide; *keel* 5.1–5.8 mm. long, the claws 1.9–2.2 mm., the blades 3.3–4 mm. long, 1.9–2 mm. wide, incurved through ± 90° to the acute or subacute apex; *anthers* 0.4–0.55 mm. long; *pod* lunately half-ovoid-ellipsoid, 6–9 mm. long, 3–4.5 mm in diameter, quite like that of var. *humivagans*, commonly purple-dotted, loosely strigulose; *ovules* 9–14.—Collections: 8 (o); representative: *Peirson 7390* (CAS); *McClintock & Robbins 6213* (CAS, NY); Kearney & Peebles *13,681, 13,686* (ARIZ).

Dry stony meadows, openings in pine forest, and at the edge of aspen groves, 7925-9000 feet, locally plentiful in and around the parks of the Kaibab Plateau north of Grand Canyon, Coconino County, Arizona.—Map No. 41B.—July to September.

ASTRAGALUS HUMISTRATUS var. TENERRIMUS (very delicate) Jones in Proc. Calif. Acad. Sci. II, 5: 649. 1895.—"No. 6052f. September 17, 1894, Buckskin Mountains, Arizona, 9000° ... No. 6064. September 20, 1894, road to Nagle's Ranch, Buckskin Mountains ..."—Lectotypus, *Jones 6064,* POM (3 sheets)! isotypus, NY (fragm.)! paratypus, *Jones 6052f,* POM!—*Batidophaca tenerrima* (Jones) Rydb. in N. Amer. Fl. 24: 136. 1929. *A. sonorae* var. *tenerrimus* (Jones) Kearn & Peeb. in Jour. Wash. Acad. Sci. 29: 485. 1939.

The present variety is closely allied to var. *humivagans* from which it is distinguished by no single good technical character but rather by a combination of small ones. In practice it may be recognized by its slender stems, small leaflets, and slenderly pedunculate racemes of few relatively small flowers. It probably represents little more than a high-altitude form of var. *humivagans;* in fact, the cited paratypus already suggests transition between the two.

100f. ASTRAGALUS HUMISTRATUS var. CRISPULUS

Gray-villous (villosulous) and often subtomentose with extremely fine, curly, ± entangled hairs mixed with others longer, loosely spreading and ascending, the longest up to 1–1.5 mm. long, the leaflets pubescent on both sides, but sometimes more thinly so above; *stems* prostrate, radiating, freely and divaricately branched, (0.5) 1.5–5.5 dm. long; *stipules* 2.5–8 mm. long. *leaves* 1–4.5 (5) cm. long, with 11–15 narrowly lanceolate to ovate, acute or subacute (when broad, obtuse), flat or loosely folded leaflets (2) 3–14 mm. long; *peduncles* (1) 1.5–3.5 (4) cm. long; *racemes* (3) 5–12-flowered, the axis (0.5) 1–3 cm. long in fruit; *calyx* villosulous like the herbage, 4.6–5.5 mm. long, the disc 0.6–0.8 mm. deep, the tube 2.9–4 mm. long, 2–2.7 mm. in diameter, the teeth 1.2–2.4 mm. long; *petals* whitish, faintly pink-tinged; *banner* 7–9.2 mm. long, (3) 4–5 mm. wide; *wings* (0.6, rarely 1.4 mm. shorter to 0.8 mm. longer than the banner) 6.7–8.6 mm. long, the claws 2.5–3.2 mm., the blades 4.6–6.3 mm. long, 1.7–2.4 mm. wide; *keel* 5.1–6.2 mm. long, the claws 2.5–3.2 mm., the half-obovate blades (2.8) 3–3.7 mm. long, 1.8–2.2 mm. wide, abruptly incurved through 90–100° to the rather sharply deltoid apex; *anthers* 0.4–0.6 mm. long; *pod* lunately half-ellipsoid, incurved through ¼–½-circle, cuneate at base, cuspidate at apex, laterally compressed and obscurely triquetrous, low-convex or shallowly grooved dorsally in the lower half or third, carinate ventrally by the suture, the thinly papery valves strigulose-villosulous with short, sinuous often mixed with a few long, straight hairs; *ovules* 6–9.—Collections: 4 (iii); representative: *Barneby 12,943, 12,948* (CAS, NY, RSA).

Dry banks and benches in xeric pine forest, in sandy soils of volcanic origin, 7250–8150 feet, local but forming colonies, known only from the White and San Francisco Mountains on the Little Colorado-Gila watershed, in the southeast corner of Apache County, Arizona, and adjoining Catron County, New Mexico.—Map No. 41.—August to September.

ASTRAGALUS HUMISTRATUS var. CRISPULUS (curly-haired) Barneby in Leafl. West. Bot. 4: 53, fig. 24–27. 1944.—"ARIZONA: ... above Nutrioso, Apache Co., alt. 8150 ft.... *Ripley & Barneby No. 5074.*"—Holotypus, collected Sept. 5, 1942, CAS! isotypus, RSA!

Immediately recognized by its villous or villous-tomentulose vesture, var. *crispulus* differs further from all other forms of the ground-cover milk-vetch in the oblanceolate or narrowly obovate banner, the more nearly obtuse keel, and the pod of uncommonly thin texture and strong lateral compression. The petals are almost clear white when fresh, faintly pink-tinged in age, but lack the infusion of yellowish or luridly purplish coloring otherwise characteristic of *A. humistratus.* The range of var. *crispulus* lies within that of var. *humistratus;* in the White Mountains colonies of the two varieties have been found in close proximity, in one case marginally overlapping. So great is the contrast between the two forms as seen growing together that one might think them specifically distinct. The link between them is var. *humivagans,* which extends eastward just into the foothills of the White Mountains and adjoining New Mexico, but generally and probably exclusively at lower elevations. A collection of var. *humivagans* from Catron County, New Mexico (Datil, *Barneby 12,911,* CAS, NY, RSA) com-

bines the vesture and broad banner typical of its sort with a small (but pluriovulate) pod nearly resembling that of var. *crispulus* in form.

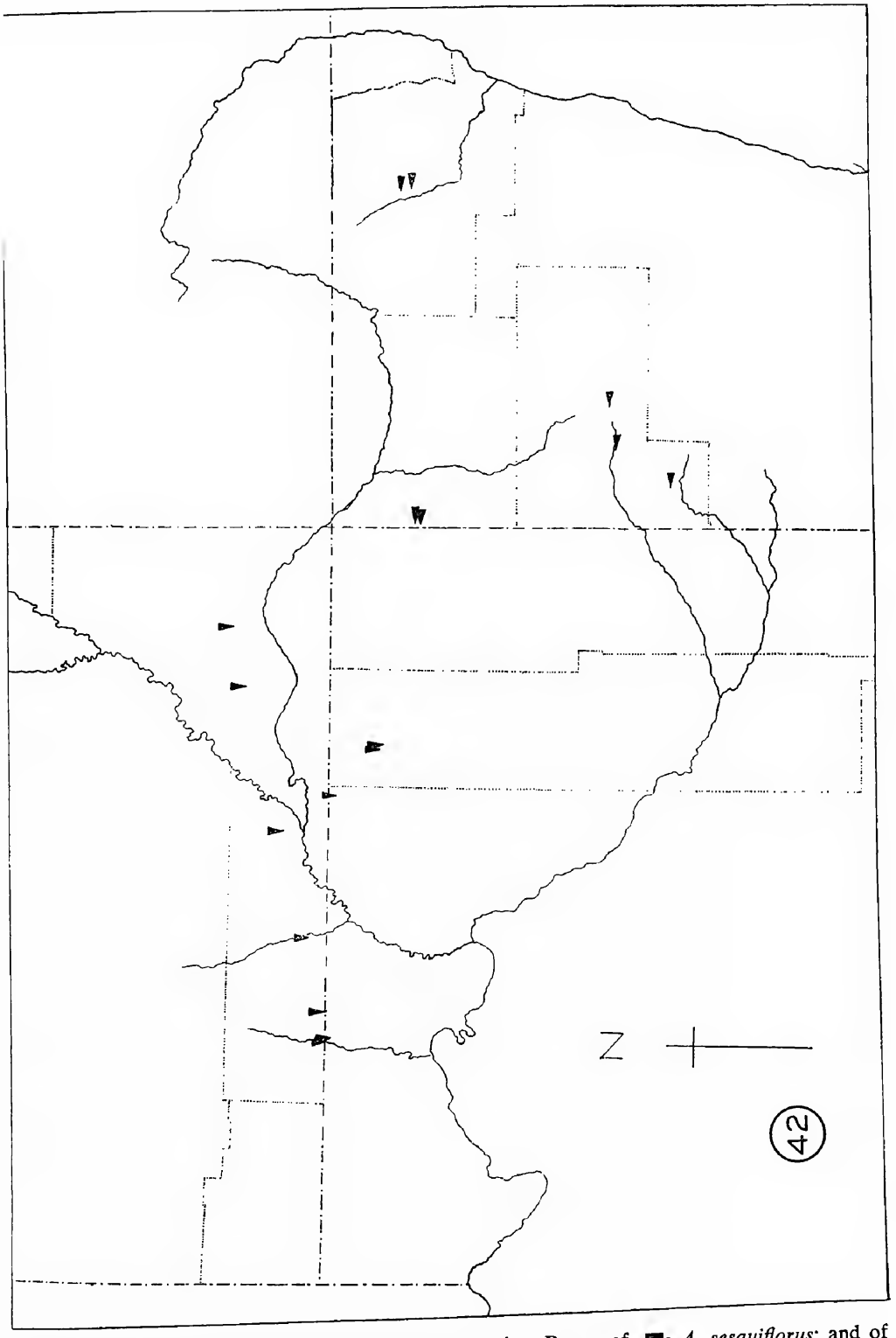
The var. *crispulus* was first collected in 1920, near Greer in the White Mountains, by W. W. Eggleston (NY).

101. Astragalus sesquiflorus

Prostrate, the numerous, slender, repeatedly branching stems forming dense mats 2–6 dm. in diameter, becoming indurated and wirily suffruticulose below, the herbage strigulose-canescent with straight or somewhat twisted hairs up to 0.2–1 mm. long; *stems* of the year 2–16 cm. long, the growing shoots more densely (and sometimes more loosely) pubescent than the leaves, the lower internodes usually short, the upper ones up to 1.5 cm. long; *stipules* subherbaceous becoming papery, broadly deltoid to ovate- or lance-acuminate, (1.5) 2–4.5 mm. long, all fully amplexicaul, connate into a loose sheath broader than the stem, the free blades often recurved; *leaves* (1) 1.5–4 cm. long, with wiry, subfiliform petioles and 7–11 (13) narrowly elliptic and acute or subacute to obovate and obtuse, dorsally keeled leaflets (1.5) 3–10 mm. long; *peduncles* filiform, (0.8) 1.5–4.5 cm. long; *racemes* loosely 1–3-flowered, the flowers ascending, the short axis produced beyond the last flower as a tapering appendage 1–8 mm. long; *bracts* lanceolate, 1.2–3 mm. long; *pedicels* at anthesis 0.7–2.5 mm. long, in fruit ascending, scarcely thickened, 1.5–4 mm. long; *bracteoles* 0–2; *calyx* 3.7–5.5 mm. long, strigulose or subvillosulous with mixed black and white hairs, the campanulate tube 1.5–2.8 mm. long, about as broad, the subulate or subulate-setaceous teeth 1.9–3 mm. long, the whole becoming papery, marcescent; *petals* pink-purple, commonly drying violet; *banner* recurved through ± 80°, broadly ovate- to suborbicular-cuneate, openly notched, 6–8 mm. long; *wings* as long or nearly so, the claws 1.9–2.5 mm., the oblong-obovate blades 4.3–6 mm. long, 1.6–2.5 mm. wide just below the rounded apex; *keel* 6–7.4 mm. long, the claws 1.7–2.2 mm., the lunately lanceolate blades 4.5–5.3 mm. long, 1.7–2.2 mm. wide, abruptly incurved near the middle through 50–80° and attenuate into a narrow, beaklike but finally obtuse apex; *anthers* 0.3–0.45 (0.5) mm. long; *pod* spreading-ascending (humistrate), sessile but sometimes elevated on a minute gynophore up to 0.8 mm. long, the body very obliquely oblong-obovoid, 8–10 mm. long, 3–4 mm. in diameter, subtrigonously compressed, flattened or shallowly sulcate dorsally toward the base, the acute, ± salient ventral suture incurved into a broad, shortly deltoid, cuspidate beak, the thin, purple-speckled or -mottled, strigulose or minutely hirtellous valves becoming papery, stramineous, finely reticulate, not inflexed; *dehiscence* apical and downward through the ventral suture; *ovules* 7–10; *seeds* brown, smooth or minutely pitted, 2.5–2.9 mm. long.—Collections: 15 (ii); representative: *Jones* (from Johnson's) *in 1890* (MO, NY, POM); *Eastwood & Howell 6285* (CAS, MO, NY, RSA, WS); *Ripley & Barneby 4340* (RSA); *Rydberg & Garrett 6324* (NY, RM); *Milton Wetherill 919/3079* (ARIZ, NY); *Darsie* (from Navajo Mt.) *in 1933* (ARIZ); *J. W. Brewer Jr. 1080/1723* (ARIZ); *Vorhies* (from Navajo Reservation) *in 1916* (ARIZ, MO, NY).

Rock ledges and crevices of sandstone cliffs, or on talus, 5000–10,000 feet, with piñon and juniper and on Navajo Mountain ascending into the spruce-fir zone, local but forming colonies, sandstone plateaus and escarpments of southern Utah and extreme northern Arizona, from the Elk Mountains, San Juan County, west to Kaiparowits Plateau and Kanab Creek, Kane County, south to Betatakin and Navajo Mountain in northern Navajo and adjoining Coconino Counties.—Map No. 42.—May to August.

Astragalus sesquiflorus (1½-, i.e., 1–2-flowered) Wats. in Proc. Amer. Acad. 10: 345. 1875.—"Southern Utah, collected by Capt. F. M. Bishop, 1873."—Holotypus, collected prob-



Map No. 42. Parts of Arizona, Utah, and New Mexico. Range of ▼ *A. sesquiflorus*; and of *A. micromerius*.

ably near Kanab, a base of operations for Capt. Powell's Grand Canyon Expedition, GH! isotypus, US!—*Tragacantha sesquiflora* (Wats.) O. Kze., Rev. Gen. 948. 1891. *Phaca sesquiflora* (Wats.) Rydb. in Bull. Torr. Club 40: 48. 1913. *Batidophaca sesquiflora* (Wats.) Rydb. in N. Amer. Fl. 24: 318. 1929.

Astragalus sesquiflorus var. *brevipes* (with short pedicels) Barneby in Amer. Midl. Nat. 55: 478. 1956.—"ARIZONA: Betatakin, Navajo Co., June 22, 1948, *J. T. Howell* No. 24531."—Holotypus, CAS! isotypi, ARIZ, RSA!

The sandstone milk-vetch, *A. sesquiflorus,* is technically similar to the commoner and less specialized *A. humistratus,* differing chiefly in the few leaflets and few flowers of a lively purple shade. So far as known it is confined to rim-rock pavement, cliffs, and shelving rock ledges of sandstone buttes and escarpments; in consequence, the populations are scattered and discontinuous, setting the stage for divergent evolution. My former attempt to discriminate between two varieties was justified by the few specimens then available, but turns out to have been premature and based on an unfair sample of the variation now known in the species. The sandstone milk-vetch is variable in flower-size, in length of the pedicels and calyx-teeth, in color of the petals, in shape of the leaflets, and strikingly so in orientation of the vesture which may be either truly appressed or crisply villosulous. Unfortunately there is no correlation between any pair of characters, and it seems impossible to divide the species at all neatly or realistically into named varieties. The exactly typical phase is confined to a comparatively small area along the foot of the Zion Escarpment at about 5000–5600 feet; it has relatively large, brightly colored flowers borne on long pedicels, long calyx-teeth, and acute or subacute, strictly strigulose leaflets. The typus of var. *brevipes* is easily distinguished from this by its smaller, paler, short-pediceled flowers, short calyx-teeth, obtuse leaflets, and especially by the incurved or curly pubescence of the leaves and stems. The following steps bridge the gap between the extremes: *Harrison 9035* (MO) from the top of Kaiparowits Plateau, with all features of var. *brevipes* except for appressed vesture; *Jones's* material from Johnson's (cited), typical except for (sometimes) shorter calyx-teeth and pedicels; *Brewer 1080/3079* (cited), an approximate topotype of var. *brevipes* but differing in long calyx-teeth and subappressed pubescence. There is a rather definite trend for short pedicels and obtuse leaflets to occur together at higher elevations, but as the whole picture of variation in *A. sesquiflorus* begins to emerge, the var. *brevipes* takes its place as only one of a series of minor variants.

The form of the sandstone milk-vetch found along Kanab Creek and eastward toward the Paria Canyon is a strikingly ornamental little astragalus. Plants rooting directly into the rock face, whether horizontal or tilted, form truly prostrate mats of innumerable, freely branching stems, which are covered for a week or so in May by a mass of small, brilliantly colored flowers. In more protected spots, where a fallen boulder or a natural hollow in the rock provides shelter from the wind, the base of the older plants (consisting of slender, ultimately suffruticulose stems of former seasons, beset with wiry, marcescent petioles) becomes impacted with sand or clay. In such places the plant is built up into soft, hemispherical cushions. The pale eye in the purple-margined banner is penciled with a fan of upwardly forking veins. Plants from the higher plateaus, not seen in the living state, seem to have weaker, more flexuous stems, flaccid and more readily deciduous petioles, and petals of a paler and more fugitive hue.

XXIV (ii). Subsectio MICROMERII

Vesture basifixed; *flowers* very small, the banner ± 5–6.5 mm. long; *pod* small, 2–4-ovulate.—Spp. 2, 1 of n.-w. New Mexico, 1 of e. Oregon.

ASTRAGALUS sect. HUMISTRATI subsect. MICROMERII, subsect. nov., *Humistratis* genuinis pube basifixa ovulisque paucis (2–4) absimiles.—Sp. typica: *A. micromerius* Barneby.

Key to the Species of Subsect. Micromerii

1. Leaflets crowded, oblong-elliptic or obovate, obtuse, conduplicate, densely silvery-hirsutulous (the hairs up to 0.5–0.8 mm. long); *pod* strongly obcompressed in the lower half, laterally compressed in the beak; n.-w. New Mexico ..... 102. *A. micromerius*
1. Leaflets distant, obovate-cuneate, obtuse, truncate, or emarginate, mostly flat, thinly villosulous (the hairs up to 0.2–0.5 mm. long); *pod* almost lenticular, obscurely depressed dorsally near the base and obtusely ridged on the lateral faces parallel to and near the dorsal suture; e.-centr. Oregon ..... 103. *A. tegetarioides*

102. ASTRAGALUS MICROMERIUS

Prostrate, matted, with a thick taproot and basally suffruticulose, repeatedly branching stems, the slender growing tips and herbage densely villous-hirstulous

with silvery, spreading or ascending hairs up to 0.5–0.8 mm. long; *stems* 0.5–3 dm., the season's growth 3–18 cm. long, branched or spurred at nearly every node, the upper internodes up to 2 cm. long, mostly shorter; *stipules* herbaceous becoming papery, ovate or ovate-acuminate, 1–3 mm. long, connate into a loosely amplexicaul, often cuplike sheath; *leaves* 4–10 (20) mm. long, with weak, deciduous petioles and (3) 5–9 crowded, subpalmately disposed, oblong-elliptic to obovate, obtuse, mostly folded and retrocurved leaflets 1–3.5 (6) mm. long; *peduncles* slender, 3–10 mm. long; *racemes* loosely 1–3 (5)-flowered, the flowers spreading, the axis not over 0.5 cm. long in fruit; *bracts* lance-ovate, 1–2 mm. long; *pedicels* at anthesis less than 1 mm., in fruit up to 1.5 mm. long; *bracteoles* 0; *calyx* 2.5–3.6 mm. long, densely silvery-hirsutulous, the disc about 0.5 mm. deep, the obconic-campanulate tube 1.5–2.5 mm. long, the subulate teeth 1–1.3 mm. long; *petals* whitish, the wing-tips lilac-tinged, the keel purple-tipped; *banner* recurved through ± 45°, obovate-cuneate, 5.5–6.5 mm. long, 3–3.5 mm. wide; *wings* 5–5.6 mm. long, the claws about 2 mm., the oblong, nearly straight, obtuse blades 3.5–3.9 mm. long, about 1.3 mm. wide; *keel* 4–4.5 mm. long, the claws 2–2.2 mm., the half-obovate blades 2.2–2.6 mm. long, 1.3–1.4 mm. wide, incurved through 90–100° to the bluntly deltoid apex; *anthers* 0.35 mm. long; *pod* spreading, mostly humistrate, obliquely ovoid, 4–5 mm. long, 2.5–3 mm. in diameter, obtuse at base, obcompressed and dorsally flattened or shallowly sulcate in the lower half, the prominent ventral suture either straight, or incurved, or slightly decurved into the laterally flattened, deltoid beak, the thin, green, ascending-hirsutulous valves becoming papery, stramineous, not inflexed; *ovules* 4; *seeds* brownish, purple-speckled, 2–2.5 mm. long.—Collections: 6 (iv); representative: *Goodman & Payson 3218* (NY); *Ripley & Barneby 10,293* (CAS, NY, RSA).

Shelving ledges of sandstone cliffs, sometimes seeding down to steep boulder-strewn talus, often partly submerged in drifting sand, local on and near the Continental Divide, at 6600–7300 feet, in San Juan, Rio Arriba, and McKinley Counties, New Mexico.—Map No. 42.—July to August.

ASTRAGALUS MICROMERIUS (small in all parts) Barneby in Leafl. West. Bot. 5: 85. 1948. —"NEW MEXICO: . . . Pyramid Rock, near Rehoboth, McKinley Co. . . . , 17 July, 1945, *Ripley & Barneby No. 7047*."—Holotypus, CAS! isotypi, F, GH, K, NY, POM, RSA, UTC!

This diminutive but none the less delightful astragalus, which may appropriately be called the Chaco milk-vetch, is similar in most respects to the so-called *A. sesquiflorus* var. *brevipes* which occupies the same type of habitat in northern Arizona. It differs importantly in its basifixed pubescence and in the reduction of the ovules to two pairs. As seen on the dry sandstone scarps and talus about the headwaters of the Puerco and Chama Rivers, *A. micromerius* strongly suggests the less rigid and prickly phases of *A. Kentrophyta* var. *implexus*, which are sometimes villosulous and may have flowers of similarly pale coloring. But the obtuse leaflets, all jointed to the rachis, and the proximally obcompressed pod are unlike any kentrophyta. The only sympatric form of *A. Kentrophyta* is the decidedly spinose var. *neomexicanus*, further distinguished by its dolabriform hairs.

The home of *A. micromerius* is a singularly bleak and waterless country, a high desert favored only irregularly and at long intervals by sufficient rain to bring the sparse vegetation into even a short period of activity. Colonies of the astragalus dwindle during prolonged drought or seemingly disappear. Individual plants vary from a few centimeters up to six decimeters in diameter, but very few survive to form mats of such a size. The species was first encountered by Dr. Washington Matthews, who collected a fragmentary flowering specimen on a mesa near Zuñi in the summer of 1883 (NY, herb. Canby.).

103. ASTRAGALUS TEGETARIOIDES

Prostrate, extremely slender and delicate, the many subfiliform stems arising from a suffruticulose caudex, freely branching at all the lower nodes, together forming mats 1–3 dm. in diameter, the herbage thinly villosulous with fine, curly or incumbent hairs up to 0.2–0.5 mm. long, greenish or cinereous, the leaflets

medially glabrescent above; *stipules* 0.8–3 mm. long, thinly herbaceous becoming papery, ovate or ovate-acuminate, amplexicaul and either connate or united by a stipular line, the upper ones progressively longer, the uppermost sometimes free to the base, their blades recurved; *leaves* 1–3.5 cm. long, with filiform petioles and (5) 7–11 obovate-cuneate, obtuse, truncate, or emarginate, flat or loosely folded leaflets 1.5–5 mm. long; *peduncles* filiform, 0.5–2.2 cm. long, shorter than the leaf; *racemes* loosely (2) 3–6 (7)-flowered, the flowers spreading-ascending and ultimately declined, the axis 3–15 mm. long in fruit; *bracts* thinly herbaceous, lanceolate, 1.3–2.5 mm. long; *pedicels* ascending or arched outward, at anthesis nearly 1 mm., in fruit up to 1.3 mm. long; *bracteoles* 0; *calyx* 2.8–3.6 mm. long, thinly villosulous with spreading or curly white hairs, the disc 0.3–0.4 mm. deep, the tube 1.3–1.6 mm. long, 1.3–1.6 mm. in diameter, the subulate teeth 1.3–1.7 mm. long; *petals* whitish, the banner faintly lilac-veined; *banner* recurved through about 45°, broadly obovate-cuneate, 4.8–5.2 mm. long, 3.6–4.1 mm. wide; *wings* as long or a trifle longer, 4.8–5.4 mm. long, the claws 1.3–1.6 mm., the broadly lunate-oblanceolate, obtuse blades 3.9–4.3 mm. long, 1.6–1.9 mm. wide; *keel* 3.5–3.7 mm. long, the claws 1.2–1.6 mm., the half-circular blades 2.1–2.3 mm. long, 1.5 mm. wide, abruptly incurved through 100–130° to the broad, deltoid apex; *anthers* 0.25–0.3 mm. long; *pod* spreading or a trifle declined, commonly humistrate, ovoid-lenticular, beakless but tipped above the apex with the curved style, 3.5–4 mm. long, 1.9–2.4 mm. in diameter, both laterally and somewhat dorsiventrally compressed and hence obscurely compressed-triquetrous, the acute ventral suture slightly less convex than the dorsal one, the valves transversely distended parallel to and near the dorsal suture to form the lateral angles, the thinly papery, pale green, ultimately yellowish valves loosely but minutely strigulose, not inflexed; *ovules* 2–3; *seeds* brown, smooth, 1.9–2.1 mm. long.—Collections: 5 (o); representative: *J. W. Thompson 13,289* (CAS, RSA, US, WS, WTU); *Maguire & Holmgren 26,735* (NY, RSA, UTC); *Peck 20,853* (WILLU).

In dry pine forest, ± 4500–5000 feet, very local, known only from Little Juniper Mountain and the upper Silvies River in westcentral and northern Harney (and possibly adjoining Grant) County, Oregon.—Map No. 35.—June and July.

ASTRAGALUS TEGETARIOIDES (resembling *A. tegetarius* = *A. Kentrophyta* var. *implexus*) Jones, Contrib. West. Bot. **10**: 66. 1902.—"No. 2619 Cusick, southern Blue Mts., Oregon, in sandy soil in the Buck Range, June 28, 1901."—Holotypus, from "summit of Buck Mt. at 4500 ft.," POM! isotypi, G, GH, K, MO, ND, NY, ORE, P, RM, US!

The bastard kentrophyta, *A. tegetariodies*, has no really close kin and might be better placed among the *Ervoidei* than among the distantly allopatric *Humistrati*. The epithet is not well chosen; for although the tiny flowers and extraordinarily few ovules can be matched in subsect. *Submonospermi (Kentrophyta)*, the plant is more easily visualized (cf. Abrams, 1944, fig. 2777) if described as a very slender, few-flowered version of *A. microcystis* or *A. vexilliflexus*. From these, however, it is distinguished by the very small but proportionately broad leaflets, loosely arranged along the leaf-rachis, and by the form and compression of the fruit. The pod of *A. tegetarioides* is apparently transitional between that of the other *Humistrati* and that of the genuine *Ervoidei*, being less strongly compressed laterally than in *A. vexilliflexus* but less so dorsally than in *A. micromerius* (cf. Jones, 1923, Pl. 7, especially the pod-section at left). I have seen only fruits restored by soaking; fresh material is required before the mode of compression can be established beyond chance of error.

Cusick's Buck Mountain, situated according to the original label in the "southern Blue Mountains," has not been identified with any certainty. Maps of eastern Oregon mention several summits of this name. The term Blue Mountains is a vague one, employed by some to denote the whole mountain system drained by the upper Deschutes, John Day, Grande Ronde, and other smaller streams flowing north to the Columbia; others restrict its use to the Blue Mountains of David Douglas, the granitic massif lying athwart the Oregon-Washington boundary and forming the divide between the Tucannon and the Grande Ronde. Peck (1941, p. 442) seems to have equated Cusick's locality with the Buck Mountain near the source of the Deschutes River in the county of the same name. But there is a more likely candidate in

northern Harney County, situated on the south slope of the Blue Mountains in the wider sense, for the only modern localities for *A. tegetarioides* (Little Juniper Mountain and points 18–25 miles north of Burns) are close at hand. The species has been called the Deschutes milk-vetch by Peck (l.c.) and the Blue Mountains locoweed by Abrams (l.c.); in the circumstances neither name seems appropriate.

XXV. Sectio OCREATI

Low, loosely tufted, ill-scented (seleniferous), caulescent perennials, with superficial root-crown or suffruticulose caudex (sometimes buried in wind-blown sand or clay); *vesture* either dolabriform or basifixed; *stipules* early becoming scarious, the lowest ones, usually all, connate; *leaves* imparipinnate, with 7–19 leaflets, the terminal one jointed or rarely confluent; *flowers* racemose, ascending, rather small, the banner 8.5–14.5 mm. long; *pedicels* at anthesis usually very short, becoming longer, disjointing in age; *calyx-tube* campanulate; *petals* lemon-yellow, whitish, or reddish- to lilac-purple, regularly graduated, the banner recurved through 45 (90)°, the keel-tip obtuse; *pod* erect (rarely declined), sessile, tardily deciduous, ovoid or oblong-ellipsoid, dorsiventrally compressed below the short beak, carinate by the ventral suture, unilocular, rather small (± 6–13 mm. long), the valves stiffly papery or leathery; *dehiscence* apical and downward through the ventral or sometimes both sutures; *ovules* 4–17.—Spp. 3, xerophytes, of the Colorado Basin, one extending to the North Platte in eastern Wyoming, to the upper Rio Grande in northern New Mexico, to the Sevier in Utah, and southern Nevada.

The section *Ocreati* as originally circumscribed by Gray consisted of three species, *A. flavus, A. humistratus,* and *A. oreganus,* two of which were known at the time only from imperfect Nuttallian type-collections. Only *A. flavus* was retained in the section as emended by Jones (1923, p. 239); this therefore becomes the lectotypus of an obviously natural group, very uniform in fruiting characters although greatly modified in other ways. The section is divisible into two subsections, the typical with dolabriform pubescence and the monotypic *Moencoppenses* distinguished by basifixed vesture and an idiosyncratic habit of growth.

The affinities of the *Ocreati* can be traced in two directions: on the one hand toward the seleniferous sects. *Racemosi* and *Albuli,* which differ in their pendulous, stipitate fruits continuous with the receptacle; and on the other toward sect. *Humistrati,* a non-seleniferous group from which they are difficult to distinguish by characters expressible in words, even though readily perceived as different. Neither Jones's sectional key (1923, p. 61) nor Rydberg's generic one (1929, p. 251) provide practical criteria separating the two groups, but all observers agree that these exist as such. The *Humistrati* are diffuse or mat-forming plants, with racemes quickly humistrate after anthesis, so that the fruits ripen in contact with the ground; whereas the peduncles and racemes of the *Ocreati* remain erect while the fruit ripens, unless artificially bowed down by the weight of the pods. The pod of the *Humistrati* ordinarily has two distinct lateral faces sloping away from the salient ventral suture, and its section at the middle is inversely ovate-obcordate. By contrast the pod of the *Ocreati* is tranversely oblong in section, about equally flattened ventrally and dorsally, and the prominent ventral suture is depressed so that it lies in a shallowly boat-shaped furrow; in fact, it is quite similar to that of *A. (Racemosi) bisulcatus* if deprived of a stipe.

Key to the Subsections of Sect. Ocreati

1. Herbage and stems densely pubescent with dolabriform hairs, cinereous or rarely greenish ..... XXV (i). Subsect. *Ocreati*
1. Herbage and stems thinly pubescent with basifixed hairs, green or yellowish-green ..... XXV (ii). Subsect. *Moencoppenses*

XXV (i). Subsectio Ocreati

Vesture dolabriform; *ovules* mostly more than 6, if only 4–6 then the racemes short and compact.—Spp. 2, range of the section.

Astragalus sect. Ocreati Gray in Proc. Amer. Acad. 6: 201. 1864, emend Jones, Rev. Astrag. 239. 1923.—Sp. typica: *A. flavus* Nutt.—*Astragalus* sect. *Ocreatus* Sheld. in Minn. Bot. Stud. 1: 157. 1894, an illegitimate substitute.

Cnemidophacos Rydb. in Bull. Torr. Club 32: 663. 1905.—Generitypus: *C. flavus* (Nutt.)

Rydb. = *A. flavus* Nutt.—*Astragalus* subgen. *Cnemidophacos* (Rydb.) Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 198. 1941.

Key to the Species of Subsect. Ocreati

1. Peduncles (3) 5–23 cm. long, usually surpassing the subtending leaf, the raceme in any case projected well above the foliage; *petals* deciduous; *ovules* (6) 8–17; widespread and variable ..... 104. *A. flavus*
1. Peduncles 1–3 (4) cm. long, shorter than the leaf, the raceme not or scarcely projected; *petals* marcescent around the fruit; *ovules* 4–5; local in Coconino County, Arizona ..... 105. *A. sophoroides*

104. Astragalus flavus

Usually low, wiry, loosely tufted, strigulose nearly throughout with straight, often flattened, appressed, dolabriform hairs up to (0.4) 0.5–0.9 (1.1) mm. long (the calyx sometimes, and even the herbage rarely, pilose-pilosulous with longer, looser, twisted hairs), the herbage cinereous or canescent, rarely greenish, the leaflets often glabrescent medially or quite glabrous above; *stems* of the year (0.5) 1–20 cm. long, in young plants several, tufted on the root-crown, in older ones numerous, arising from an extensively branching, twiggy caudex, suberect or (when long) decumbent and ascending, mostly simple, or bearing one or more spurs from the lower axils; *stipules* (2) 3–10 mm. long, all connate-amplexicaul, the lowest (sometimes all) united through nearly their whole length into a bidentate sheath, the median and upper ones commonly united for ± half their length, with erect or spreading blades; *leaves* (1.5) 3–13 (18) cm. long, all petioled, with (5) 11–19 (21) linear or linear-oblong, rarely oblanceolate, or (in some lower leaves) ovate, obtuse or subacute, usually folded leaflets (3) 6–20 mm. long, the petiole and rachis often stiff, tending to persist on the root-crown or caudex-branches; *peduncles* stout or quite slender, erect or ascending, (3) 6–23 cm. long; *racemes* (4) 10–30-flowered, oblong and rather dense at early anthesis, usually elongating, (1) 2–12 cm. long in fruit; *bracts* scarious with green midrib, or broadly scarious-margined, narrowly ovate to lance-acuminate, (1.5) 2.5–5 mm. long, often reflexed in fruit; *pedicels* at anthesis very short, subobsolete or up to 0.7 mm. long, in fruit straight, ascending, 1–1.2 mm. long; *bracteoles* 0; *calyx* variably pubescent with white or some black hairs, the subsymmetric disc 0.6–1.2 mm. deep, the campanulate tube 3–5.2 mm. long, 2.1–3.8 mm. in diameter, the subulate, lance-subulate, or linear-lanceolate teeth varying from shorter to twice longer than the tube, the whole becoming papery, ruptured, marcescent; *petals* lemon-yellow, dull straw-yellow, ochroleucous, whitish, or pale lilac, in one var. reddish-lilac, the keel-tip nearly always at least faintly maculate; *banner* recurved through 45 (90)°, broadly obovate-cuneate to rhombic-oblanceolate, 9–17.8 mm. long, 4.7–8 mm. wide; *wings* (8.8) 9.3–14.4 mm. long, the claws 2.9–5.1 mm., the oblong-oblanceolate or obliquely obovate, obtuse or subemarginate, slightly incurved blades (6.1) 6.7–10 mm. long, 1.8–3.5 (4.5) mm. wide, the inner margin of the left one infolded over the keel, the right one concave; *keel* 6.5–10 mm. long, the claws 3–5 (5.3) mm. long, the half-oblong-obovate blades 3.5–5.8 mm. long, 1.8–3 mm. wide, abruptly incurved through 90–100° to the bluntly deltoid apex; *anthers* (0.45) 0.5–0.7 mm. long; *pod* erect or ascending at a narrow angle, sessile, oblong- or ovoid-ellipsoid, 7–13 mm. long, 3.5–5 mm. in diameter, straight, a trifle incurved, or rarely a little decurved, rounded at base, contracted distally into a shortly cuspidate beak, dorsiventrally compressed, with flattened or shallowly and openly grooved dorsal face, the lateral angles obtuse, the thick ventral suture prominent but commonly depressed and lying in a double groove formed by incurving (through the pod's proximal half) of the lateral angles, the somewhat fleshy, green, densely or sometimes thinly strigulose valves becoming leathery or stiffly

papery, brownish or stramineous, smooth or faintly cross-reticulate, not inflexed; *ovules* (6) 8–17; *seeds* brown or olivaceous, smooth and lustrous, 2–2.5 mm. long.

Key to the Varieties of A. flavus

1. Calyx-teeth nearly always shorter than the tube, not conspicuously hispid with long spreading hairs; *petals* white or yellowish, rarely tinged with pale blue or lilac, the banner 11–17.8 mm. long; *leaflets* glabrous or medially glabrescent above (2)
   2. Calyx 5.7–7.6 mm. long, the broadly campanulate tube 3.7–5.2 mm. long, 2.5–3.8 mm. in diameter; *petals* cream-colored, straw- or lemon-yellow, the keel 8–10 mm. long; w. Colorado and e. Utah to Wyoming, n.-e. Arizona, and n.-w. New Mexico ..... 104a. var. *flavus*
   2. Calyx 4–6.7 mm. long, the more narrowly campanulate tube 3.2–4.2 mm. long, 2.1–2.6 mm. in diameter; *petals* whitish, sometimes tinged with pale blue or lilac, tending to dry cream-color and rarely so when fresh, mostly a little shorter, the keel 6.5–8 mm. long; e.-centr. and s.-w. Utah to n. Arizona and s. Nevada ..... 104b. var. *candicans*
1. Calyx-teeth (3) 4.5–6 mm. long, equaling or greatly exceeding the tube in length, hirsute-ciliate with some or many basifixed hairs up to 1–1.6 mm. long; *petals* reddish-lilac or -purple, the banner 9–10.5 mm. long; *leaflets* silvery-strigulose on both sides; e.-centr. Utah ..... 104c. var. *argillosus*

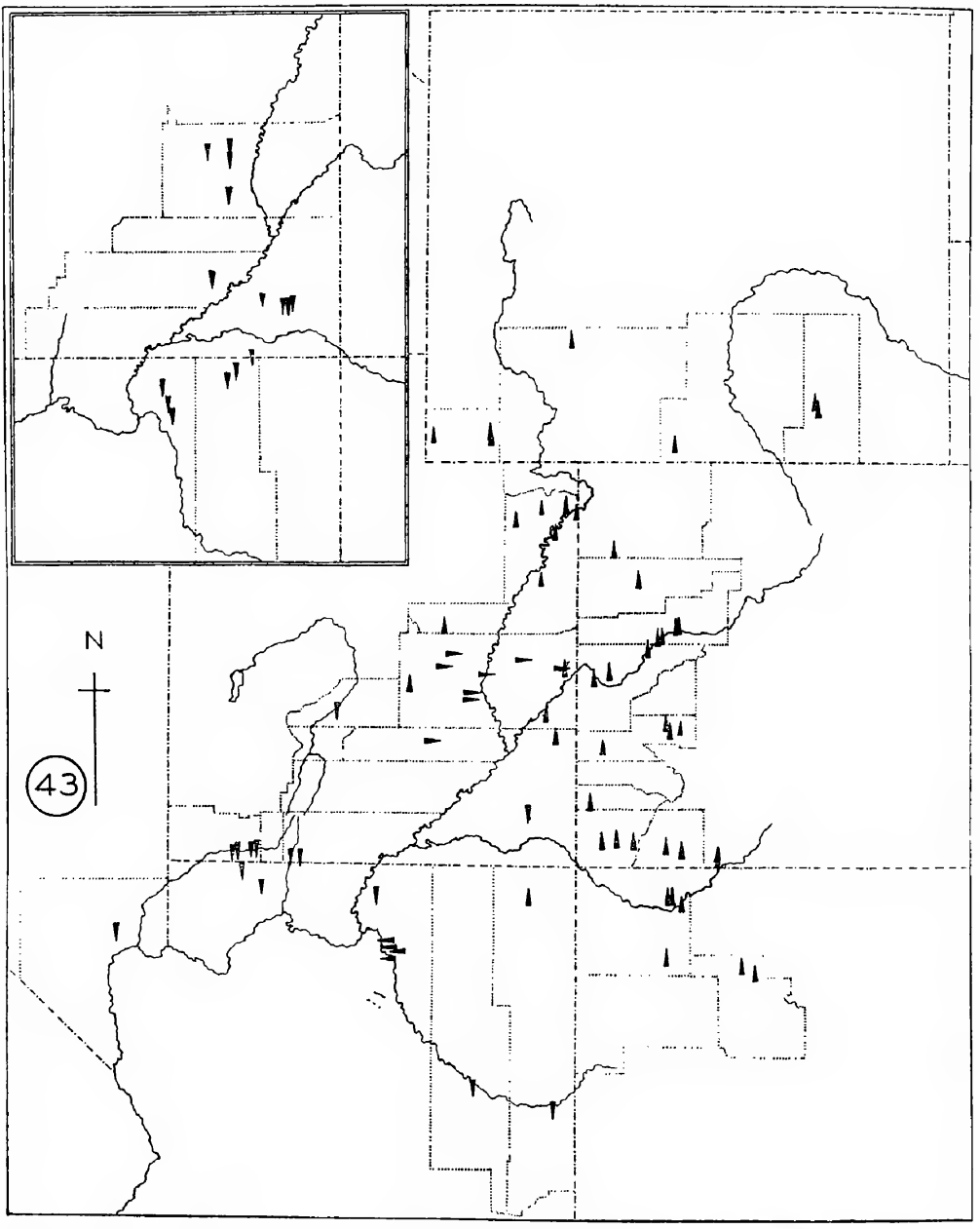
104a. ASTRAGALUS FLAVUS var. FLAVUS

Habit of the species, the individual plants long persisting, at length forming wide tufts 2–5 dm. in diameter, the caudex-branches often impacted in clay, aged plants thus acquiring a low-mounded outline; *calyx* either pilosulous or strigulose, sometimes thinly so, the hairs white, black, or of mixed colors; *ovules* (10) 13–17. —Collections: 40 (xiv); representative: *Goodding 22* (CAS, NY); *Holmgren & Tillett 9457* (NY, RSA); *C. L. Porter 3648* (NY, SMU, TEX); *W. A. Weber 4761* (CAS, OKLA, SMU, TEX, WS).

Adobe plains, barren clay flats, gullied knolls, and bluffs, in heavy alkaline soils, commonly but not exclusively on sandstone, 5300–7400 feet, locally abundant throughout the eastern half of the Colorado Basin, from the Green River in southwestern Wyoming south through the valleys of the Yampa, White, Grand, and Dolores Rivers in western Colorado and immediately adjoining Utah to the San Juan River in northwestern New Mexico and extreme northeastern Arizona, extending feebly northeast and southeast across the Continental Divide, in Wyoming to the upper forks of the North Platte, and in New Mexico to the west affluents of the Rio Grande.—Map No. 43.—Late April to July.

ASTRAGALUS FLAVUS (yellow) Nutt. ex T. & G., Fl. N. Amer. 1: 335. 1838.—"Hills of the central chain of the Rocky Mountains, towards the Oregon, *Nuttall.*"—No spm. found at BM in 1962; isotypi, labeled by Nuttall "*Phaca *flava.* R. Mts. & Columbia." or "*Phaca *flava.* R. Mts. Platte.," GH, K, NY, PH!—*Tragacantha flaviflora* (yellow-flowered) O. Kze., Rev. Gen. 941. 1891 (non *T. flava* (H. & A.) O. Kze., l.c.). *Astragalus flaviflorus* (O. Kze.) Sheld. in Minn. Bot. Stud. 1: 158. 1894, a superfluous combination. *A. Nuttallianus* (Thomas Nuttall) Speg. in An. Mus. Buenos Aires 7: 265. 1902, a superfluous substitute and later homonym. *Cnemidophacos flavus* (Nutt.) Rydb. in Bull. Torr. Club 32: 664. 1905. *Astragalus confertiflorus* var. *flaviflorus* (O. Kze.) Jones, Rev. Astrag. 241. 1923.

The yellow milk-vetch, *A. flavus,* is common in all the valleys leading westward out of the Colorado Rocky Mountains and in places so abundant that it beautifies with its prolific blossoms extensive tracts of alkaline bottomland and playa otherwise given over to the gray monotony of halophytic shrubs. Around the north and east periphery of its range the epithet *flavus* is truly appropriate and descriptive of the flowers, although the yellow color varies somewhat in intensity and tends to turn deeper in drying. It is not possible to endorse Jones's restriction of genuine *A. flavus* (1923, p. 241, as var. *flaviflorus*) to southern Wyoming, for there is no differential character which goes hand in hand with a distribution of this sort. It may be worth mentioning that the calyx-hairs tend to be longer and looser in Wyoming than southward, but even this inconsequential difference is inconstant. The var. *flavus* as understood here is easily distinguished by the key-characters given above from typical var. *candicans* as this



Map No. 43. The Colorado Plateau. Range of *A. flavus*: ◆ var. *flavus*; ▼ var. *candicans;* and ◗ var. *argillosus*; and of ◖ *A. sophoroides*. Inset, parts of northeastern Arizona and southeastern Utah. Range of *A. moencoppensis.*

occurs in the Sevier and Virgin Valleys in Utah and Nevada and in adjoining Arizona. In eastern Utah and northeastern Arizona, at relatively low elevations, the species is represented by many intermediate forms, some combining pure white petals with broad calyx-tube, others lemon-yellow petals with a narrow calyx; and the average flower varies in size around the crucial point of separation (as expressed in keel-length) brought out in the varietal key. The pod of the two varieties is identical in form, but tends to be a trifle larger in var. *flavus,* in which the ovules also are ordinarily more numerous, although this is not consistently so. It seems probable that if the typus of *A. flavus* had originated from near the center of the species-range, rather than at its northeast edge, the variations discovered subsequently would

have been accepted as deviations in two directions from an original standard, and it would be reasonable even today, in the light of a complete series of intergradations between the extreme forms of var. *flavus* and var. *candicans,* to unite them under one name. However it seems preferable for the present to maintain the traditional categories which certainly correspond with real racial modifications within the species.

104b. Astragalus flavus var. candicans

Closely resembling var. *flavus,* but usually of shorter duration, forming smaller plants when old, and sometimes flowering the first season; *calyx* (as given in the key) smaller and narrower, densely white-strigulose; *ovules* (6) 8–14.—Collections: 16 (iv); representative: *Eastwood & Howell 9289* (CAS, RSA, WS); *Jones 5294g* (CAS, NY, POM); *Ripley & Barneby 2929* (CAS, RSA).

Habitats of var. *flavus,* but at lower elevations, 2000–5900 feet, local but forming extensive colonies in the valleys of the Sevier, Virgin, and Kanab Rivers in southwestern Utah, west to the Muddy River in Clark County, Nevada, and adjoining Arizona; passing east up the Little Colorado River into Apache and Navajo Counties, Arizona, and San Juan County, Utah, these populations intergrading with var. *flavus.*—Map No. 43.—April to June.

Astragalus flavus var. candicans (turning white, of the silvery foliage) Gray in Proc. Amer. Acad. 12: 54. 1876.—"Near Richfield, Utah, at 5900 feet, in loose ashy soil, Lester F. Ward, in Powell's Expedition."—Holotypus, collected June 19, 1875, GH! isotypi, NY, PH, US *(Ward 246)*!—*A. confertiflorus* (with crowded flowers) Gray in Proc. Amer. Acad. 13: 368. 1878, based on the preceding, amplified by: "near St. George, Palmer, finely in flower" (*Palmer 113,* in 1877, GH, MO, NY!).—*Cnemidophacos confertiflorus* (Gray) Rydb. in Bull. Torr. Club 40: 52. 1913.

The var. *candicans* was originally described from ripe fruiting specimens apparently differing from the original *A. flavus,* still known at the time only from Nuttall's original gathering, in its denser silvery pubescence. Flowering material collected in the Virgin Valley by Palmer two seasons later enabled Gray to raise his variety to the rank of species, now further distinguished from *A. flavus* by its stricter and denser spikes of smaller flowers, these "not at all yellow." These criteria are still diagnostic of var. *candicans* as it occurs in Sevier, Washington, and Kane Counties, Utah, but they are not immutable. Their failure in a large area in northeastern Arizona and southeastern Utah is described under var. *flavus.*

In Nevada the flowers of var. *candicans* are agreeably fragrant.

104c. Astragalus flavus var. argillosus

Habit of var. *candicans* and differing appreciably only in the slightly smaller, purple flowers, and elongate, hirsute calyx-teeth; *herbage* commonly strigulose, sometimes also pilose with some longer, ascending hairs up to 1–1.5 mm. long; *pod* small, ± 7–10 mm. long; *ovules* 8–11.—Collections: 9 (i); representative: *Jones* (from San Rafael Swell) *in 1914* (CAS, DS, NY); *Holmgren & al. 7765* (CAS, UTC, WS); *Ripley & Barneby 8677* (CAS, RSA).

Gravelly clay flats, sandy banks, and desert washes, in alkaline soils derived from sandstone, 4000–4900 feet, locally plentiful in the Colorado Basin south of Tavaputs Escarpment, on the Price, San Rafael, Green, and Grand Rivers in Emery, Wayne, and Grand Counties, Utah.—Map No. 43.—Late April to July.

Astragalus flavus var. argillosus (Jones), stat. nov., based on *A. argillosus* (of clay soil) Jones in Zoë 2: 241. 1891.—"May 9, 1890, at Green River, Utah . . . "—No spm. at POM bears the published data. Lectotypus, collected by Jones at Green River, May 6, 1891, POM (3 sheets)! paratypi, collected at the same place on May 7, 1891, POM, WS!—*Cnemidophacos argillosus* (Jones) Rydb. in Bull. Torr. Club 40: 52. 1913.

The present variety agrees closely with var. *candicans* in growth-habit, shape and size of the petals, and small, relatively few-ovulate pod; it seems to differ from *A. flavus* as understood by Jones (his *A. confertiflorus*) only in the characters of calyx and flower-color already stressed in the varietal key. The calyx-teeth were described by Jones as reaching a length of 9 mm.; I have found none over 6 mm. long in his material, and they are quite variable in the

type-region, sometimes as little as 3 mm. long. Since there are examples of calyx-teeth up to 4 mm. long in var. *flavus*, and forms of var. *candicans* with purplish flowers, the long, spreading, basifixed trichomes on the calyx of var. *argillosus* are evidently its only unique feature. Therefore it is no longer possible to accept *A. argillosus* as a distinct species. The dispersal area of var. *argillosus* fits in neatly between those of var. *flavus* and var. *candicans* and is what one might predict for a geographic subspecies.

105. Astragalus sophoroides

Low, loosely tufted, shortly caulescent, with a slender but in older plants toughly woody taproot and shortly forking caudex, densely strigose-strigulose throughout with straight, appressed and subappresed, somewhat flattened hairs up to 0.7–1.1 mm. long, the stems canescent, the leaflets silvery or greenish-cinereous, pubescent on both faces but sometimes more thinly so above than beneath; *stems* several, slender, 2.5–20 cm. long, erect or the outer ones decumbent with incurved-ascending tips, composed of ± 6–12 internodes up to 0.3–3.5 cm. long, simple or spurred at the lower axils, commonly zigzag distally; *stipules* scarious or early becoming so, (1) 2–5 (7) mm. long, all amplexicaul and all or at least the lowest connate through half or more than half their length, with triangular, deltoid, or triangular-acuminate, erect or spreading blades; *leaves* 3–8 (12) cm. long, all petioled, with 7–13 narrowly oblong or linear-elliptic, subacute or obtuse, flat or loosely folded, rather distant leaflets 3–12 (21) mm. long; *peduncles* (0.7) 1–3 (4) cm. long, narrowly ascending, much shorter than the leaf; *racemes* 7–17-flowered, rather dense, the ascending flowers and fruits often subcontiguous, the axis little elongating, (0.7) 1–4 cm. long in fruit; *bracts* thinly herbaceous becoming scarious, ovate or lanceolate, 2–5 mm. long; *pedicels* narrowly ascending, straight, at anthesis 0.5–0.7 mm., in fruit somewhat turbinately thickened, 0.7–1 mm. long; *bracteoles* 0; *calyx* at anthesis 5–6.3 mm. long, densely (in age sometimes loosely) white-strigulose, the subsymmetric disc 0.6–0.8 mm. deep, the campanulate or turbinate-campanulate tube 3–3.6 mm. long, 2–2.6 mm. in diameter, the lance-subulate teeth 2–3 mm. long, the whole becoming scarious and a trifle accrescent, either ruptured or not, finally investing the pod; *petals* reddish-lilac, the banner with a pallid, striate eye, fading dull straw-color, withering-persistent; *banner* recurved through 45°, ovate-cuneate, 8.5–10 mm. long, 5.2–6.7 mm. wide; *wings* 7.6–8.8 mm. long, the claws 3–3.3 mm., the elliptic or ovate-elliptic, obtuse or obscurely emarginate, slightly incurved blades 5.1–6.3 mm. long, 2–2.8 mm. wide, the inner margin of the left one incurved over the keel; *keel* 5.7–6.8 mm. long, the claws 2.9–3.5 mm., the half-obovate blades 3–3.8 mm. long, 1.8–2.4 mm. wide, abruptly incurved through 100–105° to the bluntly deltoid apex; *anthers* 0.4–0.5 mm. long; *pod* erect or narrowly ascending, sessile on a minute boss, oblong-ellipsoid, 6.5–8 mm. long, 3–4 mm. in diameter, obtuse at base, contracted distally into a very short, laterally compressed, deltoid-triangular beak, either straight or a trifle incurved, strongly obcompressed below the beak, flattened dorsally, carinate ventrally by the prominent but depressed suture, the thinly fleshy, canescently strigulose valves becoming stiffly papery, stramineous, faintly cross-reticulate, not inflexed; *dehiscence* apical and downward through the ventral suture; *ovules* 4–6; *seeds* brown, smooth and lustrous, 2.3–3.1 mm. long.—Collections: 9 (iv); representative: *Peebles & Fulton 11,832* (ARIZ, CAS); *Ripley & Barneby 4873* (NY, RSA); *A. & R. Nelson 2861* (NY, RM).

Sandy flats and knolls, on ledges and in sandy pockets of dry cliffs, in desert washes, rarely on sand bars of running streams, commonly on red sandstone, forming colonies but very local, known only from the lower Little Colorado River and Moenkopi Wash, at 4200–4900 feet, in eastern Coconino County, Arizona.—Map No. 43.—May to June.

ASTRAGALUS SOPHOROIDES (resembling the dwarf, herbaceous *Sophora Nuttalliana* B. L. Turner) Jones in Zoë 2: 12. 1891.—"Collected at Willow Springs and on the Moencoppa, northern Arizona, June 10, 1890."—Holotypus, from Willow Springs, POM (4 sheets)! paratypi, from Moencoppa, June 11, 1890, POM (2 sheets), MO, US!—*Cnemidophacos sophoroides* (Jones) Rydb. in N. Amer. Fl. 24: 286. 1929.

The Painted Desert milk-vetch, *A. sophoroides*, is closely related to *A. flavus* var. *candicans*, of which it may be a specialized derivative of recent creation. Flowers and fruits of the two are closely similar in form and arrangement, although the slightly accrescent calyx, marcescent petals, and few ovules of *A. sophoroides* are peculiar. It is possible that the last two features have been derived by introgression from the sympatric *A. moencoppensis*, but nothing else about the species suggests such a cross. The short peduncles give the mature plant a characteristic squat and leafy appearance which is instantly recognized. Despite the lively reddish-lilac coloring of the newly opened flowers, *A. sophoroides* is a modest and inconspicuous astragalus. It is apparently restricted in range to an area of some ten to fifteen miles in diameter around the northern edge of the Painted Desert, extending from the neighborhood of Cameron north to Willow Spring and Tuba City, but is common locally in the region. At Cameron it has been found on sand bars of the Little Colorado, and it is fairly certain to be traced downstream eventually in the direction of Grand Canyon.

XXV (ii). Subsectio MOENCOPPENSES

Vesture basifixed: *racemes* long and very narrow; *ovules* 4–6.—Sp. 1, of the Colorado Basin.

ASTRAGALUS sect. OCREATI subsect. MOENCOPPENSES, subsect. nov., praesterim pube basifixa ab *Ocreatis* genuinis distincti, racemo spiciformi elongato, petalis marcescentibus, ovulisque paucis (4–6) insignes.—Sp. typica: *A. moencoppensis* Jones.

106. ASTRAGALUS MOENCOPPENSIS

Usually slender, sparsely leafy, with a thick, woody taproot and knotty root-crown or repeatedly forking suffruticulose caudex, the yellow-green stems and herbage thinly strigulose with straight, appressed hairs up to 0.5–0.75 mm. long, the inflorescence and calyces commonly silky-hirsute or -villosulous with ascending, straight or twisted hairs up to 0.8–1.3 mm. long; *stems* numerous, smooth and somewhat junceous, 8–25 cm. long, erect and ascending in broomlike tufts, simple or spurred in the lower axils, flexuous and often abruptly zigzag distally; *stipules* scarious or early becoming so, 1.5–7 mm. long, the lowest amplexicaul and connate into a bidentate sheath, the median and upper ones connate through half their length or less, sometimes united only by a stipular line, or apparently free, with lanceolate or deltoid-acuminate blades; *leaves* ascending or often abruptly divaricate and even recurved, 6–14 cm. long, all petioled, with slender, tapering rachis and 9–13 distant, sometimes scattered, linear, filiform, rarely linear-elliptic or -oblanceolate, acute or subobtuse, mostly tightly folded and often incurved leaflets 4–20 mm. long, the lateral ones jointed, readily deciduous in age, the terminal one usually continuous with the rachis, sometimes jointed like the rest; *peduncles* erect, (5) 7–20 cm. long; *racemes* loosely and narrowly (7) 12–30-flowered, the flowers ascending, the axis (3) 5–23 cm. long in fruit; *bracts* subherbaceous, becoming papery, lanceolate or lance-ovate, 1.5–3.5 mm. long; *pedicels* at anthesis straight, ascending, 0.3–1 mm. long, in fruit usually straight, rarely arched outward, 0.6–2 mm. long; *bracteoles* 0, rarely a minute scale; *calyx* at anthesis 5–7 mm. long, the subsymmetric disc 0.5–0.8 mm. deep, the campanulate or turbinate-campanulate tube 3–4 mm. long, 2.1–2.8 in diameter, the erect, lance-subulate teeth 2–3.5 mm. long, the whole a trifle accrescent and distended in age, closely investing but commonly ruptured by the pod; *petals* dull reddish-lilac or purplish, fading brownish, firmly attached to the disc, withering-persistent; *banner* obovate- or broadly oblanceolate-cuneate, 8.5–11 mm. long, (4) 5–6.5 mm. wide; *wings* 6.9–9 mm. long, the claws 2.5–3.3 mm., the obliquely obovate or oblong-elliptic, obtuse or subemarginate, slightly incurved blades 4.8–6.3 mm. long,

2–2.8 mm. wide; *keel* 5.7–7 mm. long, the claws 2.4–3.3 mm., the half-obovate blades 3.1–4.2 mm. long, 1.8–2.2 mm. wide, abruptly incurved through (90) 95–105° to the bluntly deltoid apex; *anthers* (0.35) 0.4–0.55 mm. long; *pod* spreading-ascending, exceptionally declined, sessile, ovoid- or oblong-ellipsoid, 6–7 mm. long, 2.3–3.4 mm. in diameter, obtuse at base, contracted distally into a short, narrowly triangular-cuspidate, slightly incurved beak, otherwise straight or nearly so, strongly obcompressed, flattened on both faces but carinate ventrally by the thick, prominent but depressed suture, the lateral angles obtuse but sometimes quite narrow, the thinly fleshy, canescently strigulose valves becoming stiffly papery, stramineous, nearly smooth, not inflexed; *dehiscence* apical and ultimately through both sutures, the valves ultimately separating; *seeds* olivaceous, brownish, or purple-speckled on an olivaceous ground, smooth or pitted, 2–4.1 mm. long.—Collections: 18 (vii); representative: *Jones* (from San Rafael Swell) *in 1914* (CAS, NY, POM, WS); *Ripley & Barneby 4731* (CAS, NY, RSA), *8672* (CAS, RM, RSA); *Barneby 12,768* (CAS, NY, RSA), *13,081* (CAS, NY, RSA), *13,144* (BRY, CAS, NY, RSA).

Barren clay knolls, debris at the foot of bluffs or cliffs, sometimes on rock ledges or in the gravelly clay alluvia of desert washes, on red sandstone and (reportedly) limestone, 4800–5700 feet, local but forming colonies, San Rafael Swell, Emery County, Utah, south to the Moenkopi in eastern Coconino County, Arizona, east to the foothills of the Abajo Mountains and Monument Valley in San Juan County, Utah, and immediately adjoining Arizona.—Map No. 43.—May to July.

ASTRAGALUS MOENCOPPENSIS (of Moencoppa, or Moenkopi Wash) Jones in Zoë 2: 12. 1891 *("Moencoppensis").*—"Collected June 11, 1890, on limestone cliffs at Willow Springs, near the Moencoppa, in northern Arizona."—Holotypus, POM! isotypi, ARIZ, GH, MO, NY, RM, US!—*Cnemidophacos moencoppensis* (Jones) Rydb. in N. Amer. Fl. 24: 286. 1929.

The Moenkopi milk-vetch is a remarkable species, superficially very different from the other *Ocreati* in its basifixed pubescence, sparsely leafy, broomlike habit of growth, and long, loose, very narrowly spiciform racemes. The contrast in vesture between the thinly strigulose stems and leaves of a yellowish-green hue and the silky-hirsutulous calyces is a particularly striking feature. However the pod is almost exactly like that of *A. sophoroides,* with which *A. moencoppensis* shares several other technical characters such as the accrescent calyx, withering-persistent petals, and few ovules, not to mention the common physiological adaptation to selenium. The Moenkopi milk-vetch has a close hereditary bond with the genuine *Ocreati,* despite its aberrant appearance.

Processes of divergent evolution are probably even now at work in various parts of the apparently discontinuous range of *A. moencoppensis.* In some populations the calyx-hairs are long and straight, in others shorter and twisted or curly. The plants from Moenkopi Wash and San Rafael Swell are alike in having the terminal leaflet continuous with the rachis in all but an occasional leaf, where the joint is represented by an obscure strangulation of the rachis; in plants from Monument Valley and the Abajo foothills, the terminal leaflets are all articulate. A noteworthy variant from Monument Valley (*J. T. Howell 24,721,* CAS, RSA) has unusually long (1.2–2 mm.), decurved fruiting pedicels and in consequence declined or deflexed pods. Furthermore the seeds are nearly twice as large (3.6–4.1 mm. long) as in typical material of the species. However in other collections from the same region (e.g., *Peebles & Fulton 11,942,* ARIZ) the fruit remains erect, and deflexed pods enclosing small seeds have been collected in San Juan County, Utah. The variation in the leaves and fruits requires further observation and evaluation in the field.

XXVI. Sectio ALBULI

Robust, malodorous (selenium-scented), caulescent perennials, with superficial root-crown or caudex; *vesture* dolabriform; *stipules* scarious, connate; *leaves* imparipinnate, the leaflets subsessile but articulate; *racemes* many-flowered, the flowers ascending at full anthesis, of moderate size, the banner ± 13–17 mm. long; *pedicels* tardily disjointing with the fruit; *calyx-tube* deeply campanulate or sub-

cylindric; *petals* whitish, regularly graduated, the banner recurved through ± 45°, the keel obtuse; *pod* declined, shortly stipitate or subsessile, persistent on the receptacle, the body narrowly ellipsoid, dorsiventrally compressed and obscurely triquetrous, unilocular, the valves papery; *dehiscence* apical and downward through the ventral suture, the valves ± coiled outward in age; *ovules* 5–11.—Sp. 1, xerophyte, of northeastern Arizona and northwestern New Mexico, flowering in late summer and fall.

ASTRAGALUS sect. ALBULI, sect. nov., *Ocreatis* propius affines, imprimis legumine declinato stipitato subtrigono, caulibus elatis ramosis, anthesique serotina distincti. A *Racemosis* quoad legumen comparandis pube dolabriformi (inter alia) diversi.—Sp. typica: *A. albulus* Woot. & St.

Rydberg included *A. albulus* in *Batidophaca* sect. *Humistratae,* where it was associated with species similar in the hair-attachment but differing in their sessile and deciduous fruits. The genuine *Humistrati,* as here defined, are non-seleniferous and are diffuse or matted plants of very different aspect. It seems more natural to align *A. albulus* with the other seleniferous synochreate sects. *Ocreati* and *Racemosi,* although it does not fit neatly into either, differing from the first in its declined, stipitate, subtrigonously compressed pods, from the second in its ascending flowers and dolabriform vesture, and from both in the repeatedly branching stems and delayed season of bloom. Both morphologically and physiologically *A. albulus* seems to be an isolated, highly modified monotype.

107. ASTRAGALUS ALBULUS

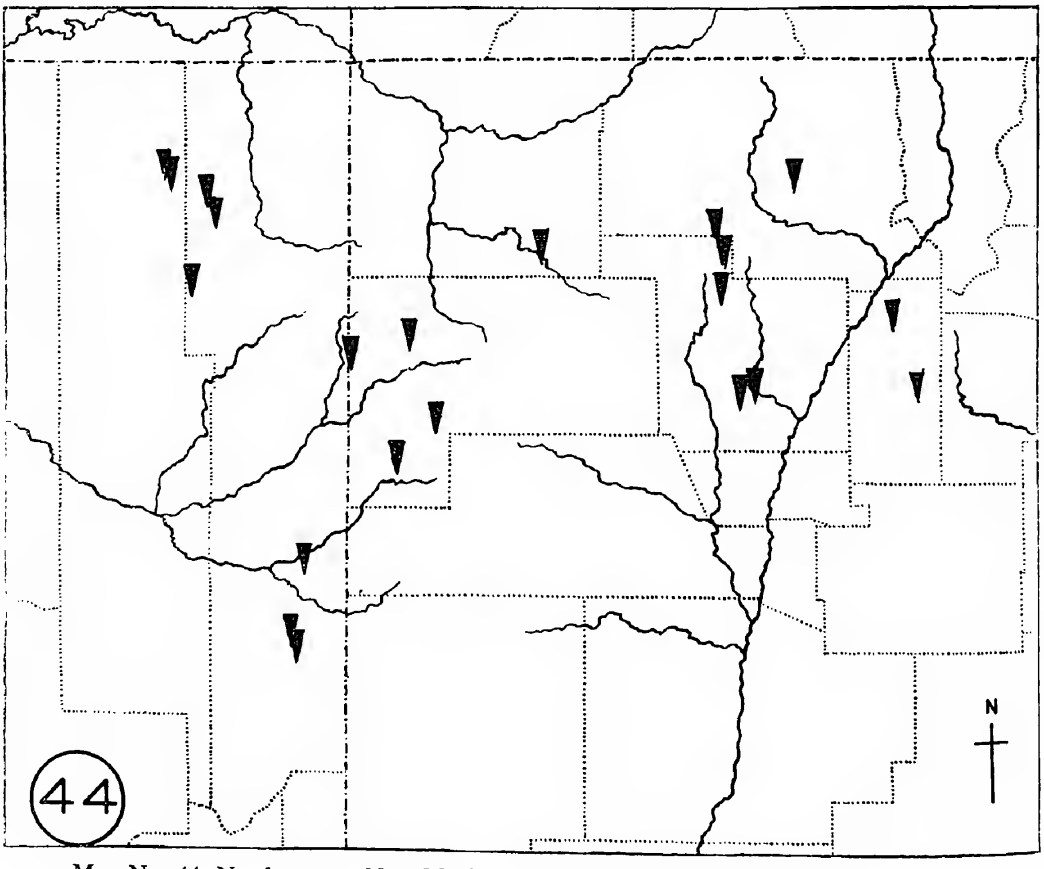
Tall and robust, with a thick, woody taproot and shortly forking, at length suffruticulose caudex, densely strigulose and strigose-pilose throughout with short, straight, appressed, together with longer, straight or sinuous, subappressed or ascending hairs up to 1–1.5 (1.7) mm. long, the stems and herbage cinereous or canescent, the leaflets pallid green and glabrous above; *stems* several or numerous, erect and strictly ascending in well-furnished clumps of bushy outline, (1.5) 2.5–7 dm. long, branched or spurred at nearly every node preceding the first peduncle, the more vigorous branches again branched or spurred; *stipules* scarious, pallid, fragile in age, 2.5–10 mm. long, all amplexicaul and connate through ± ¾ their length into a shortly bidentate (sometimes tardily ruptured) sheath; *leaves* 3–10 (14) cm. long, all but the lowest subsessile, with (7) 11–23 linear, linear-oblanceolate, or narrowly elliptic, acute or subobtuse, mostly folded leaflets (2) 4–27 (in cultivation up to 45) mm. long; *peduncles* erect, 1.5–4 (5.5) cm. long, much shorter than the leaf; *racemes* at first densely, at full maturity rather loosely (9) 15–47 flowered, the flowers at full anthesis ascending, the axis elongating, (2) 3–15 (20) cm. long in fruit; *bracts* scarious, broadly ovate or broadly lance-acuminate, boat-shaped, (2) 3–7 mm. long; *pedicels* at anthesis ascending, 0.3–0.6 mm. long, in fruit arched outward, a little thickened, 0.6–1.2 mm. long; *bracteoles* 0–2, sometimes large and conspicuous; *calyx* (7.2) 7.5–11 mm. long, strigulose or pilosulous (pilose) with white and rarely a few black hairs, the oblique disc (1) 1.2–2 mm. deep, the tube (5.4) 5.7–7.4 mm. long, 3.2–4.2 mm. in diameter, dorsally distended at base but scarcely gibbous, the narrowly subulate teeth (1.5) 1.8–3.6 mm. long, the whole becoming papery-scarious, ruptured, marcescent; *petals* whitish, the keel-tip faintly maculate; *banner* rhombic-oblanceolate, shallowly notched, 13–17.2 mm. long, (6.2) 6.6–9 mm. wide; *wings* 12.5–15.3 mm. long, the claws (5.3) 5.8–7.3 mm., the linear-oblong or -lanceolate, obtuse, nearly straight blades 7.8–9.5 mm. long, 2–2.5 mm. wide; *keel* 10.4–12.8 mm. long, the claws 5.6–7.4 mm., the half-obovate blades 5.5–6.4 mm. long, (2) 2.3–2.7 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid apex; *anthers* (0.55) 0.6–0.8 mm. long; *pod* declined or pendulous, stipitate, the stipe 0.7–2.5 mm. long, the body narrowly ellipsoid or lance-ellipsoid, gently incurved, 9–12 mm. long, 3.3–5 mm. in diameter, cuneate at base, acuminate distally into a triangular,

laterally compressed, cuspidate beak, otherwise obcompressed and subtrigonous, carinate ventrally by the slender but prominent suture, openly but often deeply sulcate dorsally, the thin, green, sparsely to densely strigulose, more rarely glabrous valves becoming papery, brownish-stramineous, finely cross-reticulate, not inflexed; *seeds* brown, smooth or sparsely pitted, not highly lustrous, 2.6–3.3 mm. long.—Collections: 26 (v); representative: *M. & G. Ownbey 3021* (CAS, NY, RSA, SMU, WS): *Deaver 3914* (ARIZ, CAS); *Barneby 12,826, 12,973* (CAS, NY, RSA); *Eastwood & Howell 6840* (CAS); *Goodding Sel.-49, Sel.-69* (ARIZ, RM).

Gullied badlands and sandy clay talus under cliffs, in selenium-bearing soils derived from shale or sandstone, 5300–7500 feet, forming colonies in scattered stations on both slopes of the Continental Divide in northwestern New Mexico and northeastern Arizona, from the Rio Grande Valley near Sante Fe north into Rio Arriba County, west to the headwaters of the Little Colorado River and to Black Mesa in Apache and Navajo Counties.—Map No. 44.—July to October.

ASTRAGALUS ALBULUS (whitish) Woot. & St. in Contrib. U. S. Nat. Herb. 16: 136. 1913.—"Type in the U. S. National Herbarium, No. 690252, collected in a canyon on the road to Zuñi some distance south of Gallup, August 1, 1904, by E. O. Wooton."—Holotypus, US!—*Batidophaca albula* (Woot. & St.) Rydb. in N. Amer. Fl. 24: 317. 1929.

The Cibola milk-vetch, *A. albulus,* is easily known by its combination of tall branching stems, dolabriform vesture, connate stipules, and shortly peduncled racemes of many whitish flowers subtended by prominent scarious, boat-shaped bracts. It is furthermore the only tall astragalus of its region likely to be found in flower and fruit from midsummer onward in the badlands. In places it is locally plentiful, commonly associated with *Eriogonum leptophyllum*



Map No. 44. Northwestern New Mexico and adjoining Arizona. Range of *A. albulus.*

Nutt. or some other suffruticose buckwheat of the *E. effusum* group and flowering with them. In spring the plants appear as neat but vigorous clumps of leafy stems, obviously healthy and obviously of the genus, but puzzlingly sterile to the unaware observer. At full anthesis they become a handsome sight, because of the number of racemes produced in succession from July or August onward until frost.

The earliest collection of *A. albulus* was made in 1882 at Fort Wingate, New Mexico, by Dr. Washington Matthews, surgeon at the post. The specimen (*Matthews 12,* GH) was in flower and left unidentified by Watson. Jones mentioned it (1923, p. 257) as representing a probably distinct relative of *A. coahuilae,* to which it bears no relationship; it was subsequently referred by Rydberg (1927, p. 22) to *A. arizonicus,* a species endemic to the Gila Basin.

XXVII. Sectio BISULCATI

Stout, coarse, malodorous (selenium-scented), caulescent perennials; *vesture* basifixed (rarely a few hairs minutely spurred at base); *stipules* membrano-scarious, at least the lowest connate (the sheath sometimes tardily ruptured); *leaves* imparipinnate, with 11–35 leaflets; *flowers* usually numerous, at first densely racemose, nodding at full anthesis, variable in size, the banner ± 7–20.5 mm. long; *calyx-tube* campanulate, oblique or dorsally gibbous at base; *petals* regularly graduated (cf. *A. bisculcatus* var. *nevadensis*), the banner recurved through 45° or rarely much further, the keel-tip obtuse; *pod* pendulous, stipitate, persistent on the receptacle but finally deciduous with the disjointing pedicel, the body linear-ellipsoid to oblong-ovoid, unilocular or nearly so, variably compressed, either trigonous, or flattened and 2-grooved ventrally, the scarcely fleshy valves becoming thinly leathery or papery; *dehiscence* primarily apical, then basal through the stipe, ultimately through the ventral suture; *ovules* 5–22.—Spp. 2, seleniferous xerophytes of the Great Plains and Colorado Plateau, Alberta to Manitoba, south to western Oklahoma, western Texas, northern Arizona, and southwestern Utah, extending feebly west into the Great Basin in eastcentral Nevada, and to the Snake-Missouri watershed in southeastern Idaho and western Montana; one disjunctly in central Mexico (western San Luis Potosí).

ASTRAGALUS sect. BISULCATI Gray in Proc. Amer. Acad. 6: 220. 1864.—Sp. typica: *A. bisulcatus* (Hook.) Gray.—*Astragalus* sect. *Bisulcatus* Sheld. in Minn. Bot. Stud. 1: 131. 1894.

Astragalus sect. *Galegiformes* Gray in Proc. Amer. Acad. 6: 200. 1864.—Sp. lectotypica: *A. racemosus* Pursh.—*Astragalus* sect. *Galegiformis* Sheld. in Minn. Bot. Stud. 1: 158. 1894.

Diholcos Rydb. in Bull. Torr. Club 32: 664. 1905.—Generitypus: *D. bisulcatus* (Hook.) Rydb. = *A. bisulcatus* (Hook.) Gray—*Astragalus* subgen. *Diholcos* (Rydb.) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Nev. Utah): 318. 1925; C. L. Porter in Amer. Jour. Bot. 26: 690. 1939.

Tium sect. *Racemosa* Rydb. in N. Amer. Fl. 24: 386. 1929.—Sp. typica: *T. racemosum* (Pursh) Rydb. = *A. racemosus* Pursh.

The section *Bisculcati* was designed to accommodate *A. bisulcatus* and *A. Beckwithii,* which Gray placed together in recognition of the similarly compressed pods. It has long been realized that the latter, differing (inter alia) in having a pod at once semibilocular and, although elevated on a stipelike gynophore, technically sessile and deciduous, is not at all closely akin to *A. bisulcatus.* As soon as Jones removed *A. Beckwithii* to sect. *Inflati, A. bisulcatus* became the residual lectotypus of its section. Modern opinion (Jones, 1923, p. 243; Rydberg, 1929, p. 280; C. L. Porter, 1939) is unanimous that the group consists of a section, genus, or subgenus of *Astragalus* composed of *A. bisulcatus* and its very close allies with similarly formed fruits. This assemblage of forms is here treated as one polymorphic species. However, I think the anomalous monotype *A. oocalycis* is better removed to a separate section. The *Bisulcati* are here augmented by a second seleniferous species, *A. racemosus,* closely resembling (and in flower often confused with) *A. bisulcatus,* with which it has every important feature in common except that the pod is trigonously compressed, with three almost equally broad faces and three acute or narrow angles. By tradition starting with Gray (1864, p. 200), *A. racemosus* has been associated with *A. Drummondii,* and since Jones's Revision (1923, p. 247) with *A. scopulorum* also, in a heterogeneous sect. *Galegiformes,* with species, that is, similar in the large, whitish flower and trigonous compression of the pod, but non-seleniferous

and with fruits fully bilocular and of thicker texture. On account of its long association with bilocular species, *A. racemosus* is thought of as a *Tium* in Rydberg's sense and therefore to possess the generic prerequisite of *Tium,* a semibilocular pod. Rydberg (1929) described the septum as "very narrow," and Jones's figure (1923, Pl. 63) shows a rudimentary partition, although the fruit is described earlier (op. cit., p. 246, in clave) as "not two-celled." In reality there is ordinarily no trace of septum, only rarely a rudiment. When truly unilocular the fruit of *A. racemosus* is structurally identical with that of *A. bisulcatus* except for its mode of compression, a feature in *Astragalus* which can be disturbed or greatly modified by mutations scarcely affecting other organs. I feel that sect. *Bisulcati* as here defined is a natural and physiologically homogeneous group.

Key to the Species of Sect. Bisulcati

1. Body of the pod dorsiventrally compressed, the dorsal face low-convex, the ventral face depressed, doubly grooved lengthwise, the suture salient but lying in the double groove ..... 108. *A. bisculcatus*
1. Body of the pod trigonously compressed, the angles all narrow and acute or subacute, the three faces of equal width or nearly so, all flat or slightly concave, the dorsal face sometimes a little narrower than the lateral ones and shallowly sulcate ..... 109. *A. racemosus*

108. Astragalus bisulcatus

Coarse or sometimes quite slender, ill-scented, leafy perennials, with a thick, woody, pluricipital taproot, strigulose with fine, straight, appressed hairs up to 0.3–0.6 mm. long, often quite thinly so, the thick-textured herbage either bright green or pallid and subglaucescent, occasionally cinereous when young, the leaflets glabrous or nearly so above; *stems* several or numerous, either erect and ascending in clumps or decumbent with incurved-ascending tips, 1.5–5 (7) dm. long, simple or branched (spurred) at 1–3 nodes preceding the first peduncle, commonly fistular at base, green or purplish-tinged; *stipules* submembranous early becoming pallid and scarious, 2.5–12 mm. long, the lowest broadest and shortest, at least in vernation connate into a subtruncate or bidentate (in age fragile and often ruptured) sheath, the median and upper ones progressively less connate upward, the uppermost free or united by a stipular line, with deltoid or triangular-acuminate, spreading or deflexed blades; *leaves* (3) 4–12 cm. long, the lowest shortly petioled, the rest subsessile, with (7) 15–35 ovate-oblong, oblong-elliptic, lance-elliptic, or oblanceolate, obtuse (but often mucronulate), exceptionally emarginate, or (in some upper leaves) linear-elliptic and acute, flat or loosely folded leaflets 0.5–3.2 cm. long; *peduncles* 2.5–13 cm. long, erect or (from decumbent stems) vertically ascending or incurved; *racemes* 25–80-flowered, dense and ovoid to narrowly cylindroid in early anthesis, the flowers early nodding ± retrorsely imbricated, becoming looser (especially at base), the axis elongating, 3–25 cm. long in fruit; *bracts* membranous, lanceolate, nearly always surpassing the pedicel, deflexed in age; *pedicels* slender or filiform, straight and ascending or arcuately spreading, at anthesis 1–2.5 (3) mm., in fruit 1.7-3 mm. long; *bracteoles* 0–2, sometimes conspicuous; *calyx* 3.5–9.6 mm. long, strigulose with white or some black hairs, the strongly oblique disc 0.6–1.1 mm. deep, the obliquely campanulate, membranous, pallid, purplish, or dark red tube 2.8–5.7 mm. long, either truncate at base and inserted on the pedicel by its ventral corner, or tumid and gibbous-saccate behind the pedicel, the teeth variable, subulate or sometimes setaceous, longer to much shorter than the tube, the ventral pair usually shortest, the whole becoming papery, marcescent unruptured; *petals* white, ochroleucous, dull straw-yellow, purplish-suffused or -veined, or bright rose-purple (drying violet), when pallid the keel-tip usually masculate; *banner* oblanceolate to oval-obovate, somewhat sigmoidally arched, the blade recurved through ± 45° (or in one var. more than 90°), 6.7–17.5 mm. long; *wings* usually shorter, the blades oblong-oblanceolate, obtuse, truncate, or rarely emarginate, straight or slightly incurved; *keel* 7–13 mm. long,

usually shorter than wings or banner (in one var. surpassing the banner), the blades lunately half-elliptic, rarely oblong or half-oblanceolate, gently or abruptly incurved to the bluntly rounded apex; *anthers* 0.45–0.8 mm. long; *pod* pendulous, stipitate, the slender, straight stipe ± as long or a little longer than the calyx-tube, the body linear-ellipsoid, ellipsoid, or oblong-ellipsoid, straight or a trifle in- or decurved, 6.5–20 mm. long, 2–4.5 mm. in diameter, usually cuneate but sometimes acuminate or abruptly contracted at either end, cuspidate at apex, obcompressed, with low-convex dorsal face and filiform dorsal suture, the ventral face flattened and excavated lengthwise along both sides of the elevated and ± thickened suture as two deep and narrow, or (when fully mature) shallow and open grooves, the thin, green, strigulose or glabrous valves becoming thinly leathery or papery, stramineous, either nearly smooth, reticulate, or cross-rugulose, not inflexed; *ovules* 5–15; *seeds* brown, smooth but dull, 2.5–3.4 mm. long.

The concept of *A. bisulcatus* as a single polymorphic or pluriracial species equivalent (always excepting the very distinct *A. oocalycis*) to the whole genus *Diholcos* as elaborated by Rydberg, or a subgenus of the same name as treated by C. L. Porter (1939), was foreshadowed by Jones as early as 1891 (in Zoë 2: 240). Rydberg's microspecies are examined in detail below; I am concerned here only with some aspects of the latter revision, with which the present account is most likely to be compared. Porter maintained in this immediate group three species, *A. bisulcatus, A. Haydenianus,* and *A. haydenioides,* which he defined principally in terms of calyx- and pod-measurements, and the presence or absence of transverse nervature or wrinkling of the ripe pod-wall. Smooth and relatively large pods (the body 12–20 mm. long) together with large flowers (calyx-tube 4–6 mm., corolla 12–20 mm. long) were attributed to *A. bisulcatus,* and to the other two a shorter pod (the body 8–10 mm.) and small flowers (calyx-tube 2–3 mm., corolla 12 mm. or less long). In the small-flowered group *A. Haydenianus* was said to differ from *A. haydenioides* by its comparatively large flower (8–12 mm., not 6–7 mm. long) and cross-reticulate as opposed to smooth pod. The criteria are often valid; but too many individual plants and populations of like plants, combining characters of more than one of Porter's species, have come to my attention. Some specimens, for example, from northern New Mexico which could confidently be identified as *A. bisulcatus* because of their large flowers have small, smooth pods less than 1 cm. long. Similarly the form from southern Utah described by Jones as *A. Haydenianus* var. *major,* with flowers about 12 mm. long (on the cusp between *A. Haydendianus* and *A. bisulcatus*), often present fruits over 1 cm. long with only faintly reticulate valves. The flowers and fruits of the disjunct var. *nevadensis* fall most nearly within the range of variation assigned to *A. Haydenianus,* but the small pod is often nearly smooth. Yet again, plants from the Gunnison Valley in Colorado combine the medium-sized flower attributed to *A. Haydenianus* with a perfectly smooth pod up to 13 mm. long. Enough has been said to illustrate the absence of correlation in size of flower and fruit which Porter assumed to exist in this group. Falling back finally on a rugulose-reticulate pod as a firm criterion for *A. Haydenianus,* we encounter new difficulties insofar as a pronounced reticulate condition is not correlated with definite pod- or flower-size. In fact no really sharp discontinuity in variation has been found in any one differential character, so it seems desirable to treat the complex as a single species. I might add that the key offered by Jones (1923, p. 244) to discriminate between *A. bisulcatus* and *A. Haydenianus* is irrelevant to perhaps half the material of the group now available.

Among papers found after Sereno Watson's death was the description of a new astragalus, *A. grallator,* so named because of the greatly elongated erect pedicels, fancifully reminiscent of stilts. The typus was collected by Alice Eastwood from a colony of *A. bisulcatus* var. *Haydenianus* at Steamboat Springs, Colorado, and has been generally and beyond any doubt correctly interpreted as an abnormal state of the latter. A similar form of var. *nevadensis* was found in northeastern Nevada by Torrey (NY) as early as 1865; and one of var. *bisulcatus* (*Ripley & Barneby 8310,* CAS, RSA) in central Colorado, this also associated with normal plants. In the last instance the ovaries and pollen seemed to be normally formed, and there was no obvious sign of insect injury. In the extreme state the altered pedicels may reach a length of 17 mm. and bear a small, amorphously modified, usually sterile pod erect in the same plane. The teratological *grallator* form is not confined to sect. *Bisulcati,* having been noted in some *Megacarpi,* and once in *A. alpinus.* Its cause remains to be investigated.

Key to the Varieties of A. bisulcatus

1. Banner (8–17.5 mm. long) longer than the keel by at least 0.2 and up to 5 mm., at full anthesis gently recurved through ± 45°, sometimes further in withering; *petals*

white, ochroleucous, or purple, but not dull straw-colored; *bracts* 2.5–7 mm. long (2)

2. Pod either smooth or faintly reticulate, but if reticulate the body over 1 cm. long and never truly rugulose; *banner* 10–17.5 mm. long; range almost that of the whole species ..... 108a. var. *bisulcatus*

2. Pod prominently cross-reticulate, the lateral angles rugulose, the body less than 1 cm. long; *banner* 10 mm. long or less; n.-w. New Mexico and adjoining Arizona and Utah, n. through w. Colorado to n.-e. Utah and s.-w. Wyoming ..... 108b. var. *Haydenianus*

1. Banner (6.7–9.2 mm. long) shorter than the keel by 0.8–2 mm., at full anthesis abruptly bent backward over the calyx; *petals* dull straw-yellow; *bracts* 1–2.5 mm. long; e.-centr. Nevada ..... 108c. var. *nevadensis*

108a. Astragalus bisulcatus var. bisulcatus

Usually stout and thinly pubescent, the stems sometimes glabrous; *leaflets* (11) 15–29, (0.5) 1–2.5 (3.2) cm. long; *racemes* 25–75-flowered, the axis 5–18 cm. long on fruit; *bracts* (2) 2.5–7 mm. long; *calyx* either pallid or red-purple, the tube 3.3–5.7 mm. long, 2.4–4 mm. in diameter, the subulate or subulate-setaceous teeth mostly 1.5–4.5 (6) mm., rarely only 0.7–1.3 mm. long; *petals* rose-purple, pallid but ± tipped or suffused with purple or lilac, or (as commonly) whitish with maculate keel-tip, rarely pure white; *banner* (10) 10.5–17.5 mm. long, 5–7 mm. wide; *wings* (9.5) 10.5–14.5 mm. long, the claws 3.9–6.5 mm., the blades (6) 7.4–10 mm. long, 2–3.2 mm. wide; *keel* (9.6) 10–13 mm. long, the claws 3.8–6.8 mm., the blades 5.6–8 mm. long, 2.6–3.3 mm. wide; *anthers* (0.55) 0.6–0.8 mm. long; *stipe* of the pod 3–5 mm. long, the *body* linear- or narrowly oblong-ellipsoid, (8) 10–17 (20) mm. long, 2–4.5 mm. in diameter, smooth or faintly reticulate, glabrous or strigulose; *ovules* 4–14 (15).—Collections: 194 (xv); representative material cited below.

Plains, prairies, gullied clay hills and knolls, perhaps most abundant in alluvial clay soils of bottomlands and canyon floors but often found on dry gravelly soils of hillsides and benches, adapted to many types of habitat and bedrock but commonest on sedimentary formations, especially sandstones, limestones, and shales, 1900–7600 feet, widespread and all too common over the plains and prairies east of the Rocky Mountains, from the headwaters of the Pecos and Canadian Rivers in northeastern New Mexico north to the Peace River in Alberta and the Pembina in southwestern Manitoba, west across the Continental Divide to upper Clarks Fork in western Montana and just into the Snake River drainage in eastcentral Idaho, and west in New Mexico to the upper Rio Grande Valley; also represented by relatively small-flowered variants in scattered stations around the Colorado and Green River Basins in southwestern Wyoming, western Colorado, central and southwestern Utah, and extreme northcentral Arizona.—Map No. 45.—May to August.

Astragalus bisulcatus (Hook.) Gray in Pac. R. R. Rep. 12: 42, Pl. 1. 1859, based on *Phaca bisulcata* (two-grooved, of the pod) Hook., Fl. Bor.-Amer. 1: 145. 1831.—"Plains of the Saskatchewan, *Drummond*."—Holotypus, K! isotypus, GH!—*Tragacantha bisulcata* (Hook.) O. Kze., Rev. Gen. 943. 1891. *Diholcos bisulcatus* (Hook.) Rydb. in Bull. Torr. Club 32: 664. 1905.

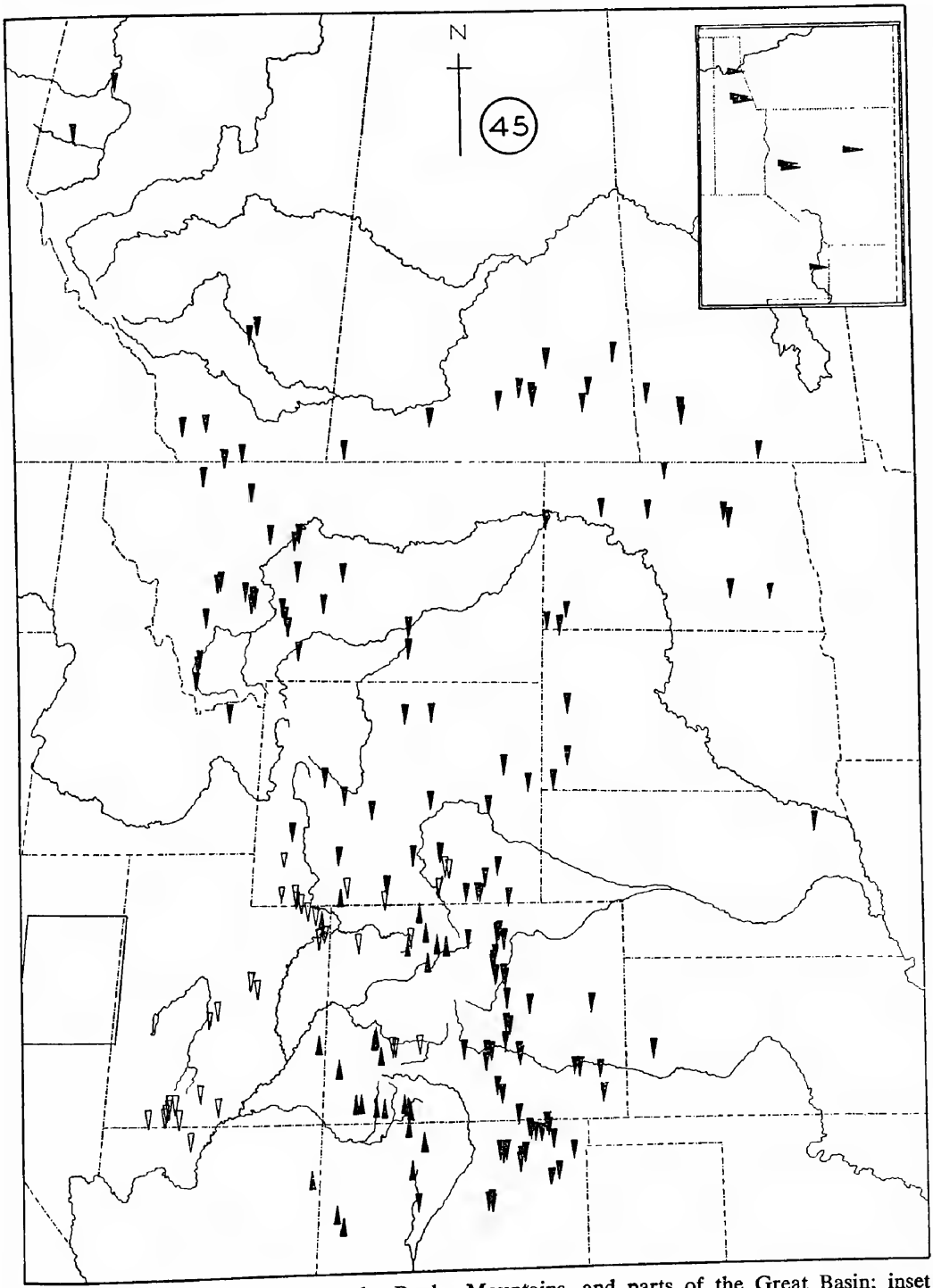
Astragalus Haydenianus var. *major* (larger) Jones in Zoë 2: 240. 1891.—"Collected June 20, 1890 . . . at Johnson, southern Utah . . . "—Holotypus, POM! isotypus, NY!—*A. scobinatulus* (somewhat roughened, like a rasp) Sheld. in Minn. Bot. Stud. 1: 24. 1894. *Diholcos scobinatulus* (Sheld) Rydb. in Bull. Torr. Club 40: 51. 1913.

Astragalus bisulcatus fma. *hedysaroides* (resembling some *Hedysarum*) Gand. in Bull. Soc. Bot. Fr. 48: xiv. 1902.—"A. Nelson exs. No. 1316 . . . Wyoming, ad Laramie Plains (Nelson)."—Holotypus, LY! isotypus, from "Table Mountain, July 1, 1895," RM!

Astragalus Haydenianus fma. *leiocarpus* (with smooth fruit) Gand. in op. cit.: xv. 1902 (*"leiocarpa"*).—"Hab. Colorado, ad Fort Collins (S. [sic] Crandall)"—Holotypus, collected June 22, 1898, LY!

Astragalus Haydenianus fma. *Nelsonii* (Aven Nelson) Gand. in op. cit.: xv. 1902.—"A. Nelson exs. No. 3711 . . . Hab. Wyoming, ad Bitter Creek (Nelson)."—Holotypus, collected July 12, 1897, LY! isotypus, RM!

Astragalus bisulcatus fma. *decalvans* (growing bald) Gand. in op. cit.: xv. 1902.—"Hab.



Map No. 45. The Great Plains, the Rocky Mountains, and parts of the Great Basin; inset (as boxed on the main map), a portion of eastcentral Nevada. Range of *A. bisulcatus*: ▼ var. *bisulcatus* (▽ the Basin variant); ▲ var. *Haydenianus*; and ◆ var. *nevadensis*.

Colorado, ad Fort Collins (C. Crandall)."—Holotypus, from "6–8 miles n. of Fort Collins, May 22–28, 1898.," LY!

Diholcos micranthus (small-flowered) Rydb. in Bull. Torr. Club 34: 420. 1907.—"COLORADO: La Veta, 1896, *C. L. Shear 3569* (type) . . . "—Holotypus, collected July 13, 1896, NY! —The description based partly on material of var. *Haydenianus;* cf. discussion infra.—*Astragalus Diholcos* (the generic name) Tidest. in Proc. Biol. Soc. Wash. 50: 20. 1937, a legitimate substitute (non *A. micranthus* Desv., 1814). *A. haydenioides* C. L. Porter in Amer. Jour. Bot. 26: 693. 1939, proposed for the same purpose as the preceding.

The two-grooved milk-vetch is a handsome floriferous plant, even if inclined to be rankly leafy, and is easily recognized by its connate stipules, basally pouched calyx, and pod of characteristic form. On warm days and while drying in the press, the herbage gives out a strong smell of selenium disagreeable to most people and to some actually nauseating. It is one of the most dangerous and widely dispersed of the seleniferous stock poisons. In its main range to the east of the Divide (and feebly west of it in Montana and Idaho) var. *bisulcatus* varies little except in the color of the calyx and petals and in pubescence of the fruit. Plants with purple flowers and usually bright red calyces are most common, often occurring in pure stands. These are sometimes mixed with whites or pinkish-lilacs, with which the calyx also varies in depth of coloring from red to almost white and the keel-tip likewise from deeply to faintly maculate. Pure stands of pale-flowered plants are relatively rare, becoming perhaps more frequent from Colorado southward. The pod of var. *bisulcatus* is ordinarily strigulose, but a glabrous variant is found sporadically from central Colorado northward into Canada. The typus of var. *decalvans* was apparently of this sort, although *Diholcos decalvans* as interpreted by Rydberg included a preponderant element of *A. racemosus* var. *longisetus*. The following collections represent typical var. *bisulcatus* and minor variants mentioned up to this point: *J. M. Macoun 29,856* (NY); *Macoun & Herriott 70,474* (CAS, ND, NY); *Hitchcock & Muhlick 11,648* (CAS, NY, RSA, WS), *11,799* (CAS, RSA, WS); *C. L. Porter 2779* (NY, RM, TEX, WS, WTU); *W. A. Weber 4674* (CAS, SMU, TEX, WS); *Clokey 3804* (CAS, NY, WS, the sheet at CAS having partly glabrous, partly pubescent fruits).

On the prairies the flower of var. *bisulcatus* is relatively large, with banner about 13–17.5 mm. long in all except an occasional starveling individual or in rare depauperate populations, such as occur in exceptionally arid microhabitats; and the ovules are relatively numerous, mostly 5–7 pairs. In the Colorado Basin the two-grooved milk-vetch is represented by a perplexing series of forms with banner 10–14 mm. long and only 2–5 pairs of ovules, which are intermediate in flower-size between the eastern var. *bisulcatus* and var. *Haydenianus*. In western Colorado and southern Wyoming the flowers are not only small but also of pale coloring, the calyx-teeth are commonly short (0.7–1.8 mm.), and the plants simulate var. *Haydenianus* closely, although the pod is smooth or only faintly reticulate and always longer (cf. *A. Nelson 3711* = fma. *Nelsonii; Ripley & Barneby 5451, 10,603,* RSA; *Hitchcock & al. 3908,* CAS, WS, WTU). In southwestern Utah and adjoining Arizona the form described as *A. Haydenianus* var. *major* combines the relatively small flower-size and few-ovulate, smooth pod described above with purple or purplish petals, longer calyx-teeth (as in exactly typical var. *bisulcatus*), and relatively few (mostly 15–19 as opposed to common counts of 17–29) leaflets. This last form is especially common around the foot of Zion Escarpment (*Ripley & Barneby 4795, 4819; Eastwood & Howell 1134,* CAS, NY) but extends north to the Sevier Valley in Sanpete County and apparently to Price in Carbon County (*Jones 5446,* CAS, NY, POM). Having failed in my search for differential characters other than ovule-number to distinguish these forms from the occasional small-flowered variants of var. *bisulcatus* from east of the Rocky Mountains, I regard them as taxonomically negligible "Basin Variants," a term which I have used freely in annotating specimens.

The reduction of *Diholcos micranthus,* which has been maintained as a distinct species by Tidestrom and Porter, deserves further comment. The species was originally based on four gatherings from Colorado (all NY!). Two of these, *Shear 3569,* the specified *holotypus,* and *Clements 100,* represent small-flowered forms of var. *bisulcatus* as defined in these pages; the other two (*Tweedy* and *Smith*) are characteristic var. *Haydenianus*. The description of *D. micranthus* incorporates the tiny flower (corolla "6–7 mm. long") of the *Haydenianus* elements and the smooth pod of the other. No example of these two features on one plant is known to exist, so *D. micranthus* is an illusory concept. Although Porter continued to define his equivalent *A. haydenioides* in almost the original terms, he distributed at least one collection under the name *A. Diholcos* (*Porter 3239,* NY), in which the banner reaches a length of 11 mm. and the body of the pod 14 mm. These plants represent one of the Basin Variants of var. *bisulcatus*.

The Greene herbarium (ND) possesses two specimens of var. *bisulcatus* (*Wooton 532,* from Springer, New Mexico; *C. F. Baker 5* in 1901 from westcentral Colorado—more pre-

cisely, according to the duplicate at POM, from the Arkansas Valley in Fremont County), filed under the epithets *abductus* and *galericulatus*. These proposals of Greene's were never published.

108b. Astragalus bisulcatus var. Haydenianus

Usually robust, the stems commonly decumbent and radiating, sometimes erect and ascending in clumps, (1.5) 3–5 (7) dm. long; *leaflets* (13) 21–35, 0.5–2.7 cm. long; *racemes* mostly 35–80-flowered, becoming narrowly cylindrical, the fruiting axis (4) 5.5–25 cm. long; *bracts* (2.5) 3–5 mm. long; *calyx-tube* pallid, 3.1–4 mm. long, 2.3–2.7 mm. in diameter, the subulate teeth 1–2.7 mm. long; *petals* white or whitish; *banner* 8–11 mm. long, (3) 3.3–5 mm. wide; *wings* 7.1–10.2 mm. long, the claws 3.3–4.7 mm., the blades (4.6) 5–6.7 mm. long, 1.4–2.1 mm. wide; *keel* 6.7–9.6 mm. long, 0.5–2.5 mm. shorter than the banner, the claws 3–4.2 mm., the blades (3.8) 4.3–6 mm. long, (2) 2.2–2.6 mm. wide; *anthers* 0.45–0.6 mm. long; *stipe* of the pod 1.4–3 mm. long, the *body* ellipsoid or oblong-ellipsoid, (5) 6.5–9.5 mm. long, 2–4 mm. in diameter, the valves strigulose with white or black hairs, transversely rugulose-reticulate; *ovules* 5–8.—Collections: 35 (iv); representative: *W. A. Weber 4741* (CAS, OKLA., SMU, TEX, WS); *Bethel, Willey & Clokey 4194* (CAS, NY, WS); *M. & G. Ownbey 3024* (CAS, NY, RSA, SMU, WS); *A. Nelson 3786* (NY); *Ripley & Barneby 5320* (CAS, NY, RSA).

Sagebrush plains, dry hillsides, and gullied bluffs, sometimes in great abundance on over-grazed pastures, in stiff alkaline clay, black shale, or sandy clay overlying sandstone, 6500–8750 feet, locally common on the west slope of the Rocky Mountains in Colorado, about the headwaters of the Yampa, Grand, and thence south to the middle Gunnison and upper San Juan Rivers, extending north along Vermillion Creek just into southern Sweetwater County, Wyoming, west into the Uinta Basin and foothills of the La Sal Mountains in extreme eastern Utah, and south and southwest to the upper Little Colorado in northwestern Apache County, Arizona, and McKinley County, New Mexico, and to the Rio Grande drainage at the head of Rio Puerco in Sandoval County.—Map No. 45—May to July.

Astragalus bisulcatus var. Haydenianus (Gray), comb. nov., based on *A. Haydenianus* (Ferdinand Vandeveer Hayden, 1829–1887, leader of the Hayden Survey of the Rocky Mountains, "one of the most indefatigable and distinguished explorers of the region") Gray ex Brand. in Bull. U. S. Geol. Surv. 2^8: 235. 1876.—"South-western Colorado, between Parrott City and the Mancos, 8000 feet."—Holotypus, *Brandegee 1285*, collected (at "7000 ft.") in the summer of 1875, GH! isotypi, K, US!—*Tragacantha Haydeniana* (Gray) O. Kze., Rev. Gen. 945. 1891. *A. bisulcatus* var. *Haydenianus* (Gray) Jones in Zoë 2: 240. 1891, nom. provis., in syn. *Diholcos Haydenianus* (Gray) Rydb. in Bull. Torr. Club 32: 664. 1905.

Astragalus grallator (stilt-walker, from the abnormally elongate pedicels) Wats. in Zoë 3: 52. 1892.—"At Steamboat Springs, Routt County, Colorado."—Holotypus, collected in July, 1891, by Alice Eastwood, GH! isotypi, CAS, MINN. (2 sheets), US! *Homalobus grallator* (Wats). Rydb. in Bull. Torr. Club 32: 666. 1905.

The Hayden milk-vetch is remarkable for the great number and small size of its nodding, retrorsely imbricated flowers which are disposed in elongate, cylindric racemes of a finger's thickness. In New Mexico and southwestern Colorado the stems are usually diffuse and form low, leafy clumps from which the inflorescences arise vertically like candles; elsewhere the stems are as often erect and ascending in the manner of var. *bisulcatus* in the Prairie States. The hairs on the small, cross-reticulate pod vary from white to black.

108c. Astragalus bisulcatus var. nevadensis

Rather slender, the decumbent and incurved-ascending stems 1.5–3 dm. long; *herbage* green or cinereous; *leaflets* (7) 11–19, those of the lower leaves sometimes emarginate; *racemes* (15) 25–45-flowered, narrowly cylindric, the fruiting

axis (3) 6–20 cm. long; *bracts* 1–2.5 mm. long, *calyx-tube* 2.8–3.2 mm. long, 2–2.3 mm. in diameter, the subulate teeth 0.7–1.6 mm. long; *petals* dull straw-yellow, the keel tipped with sordid lilac; *banner* at full anthesis abruptly recurved through ± 130°, 6.7–9.2 mm. long, 3.8–4.8 mm. wide; *wings* slightly longer, the claws 2.7–3.2 mm., the subsymmetrically elliptic and acute or subacute blades 5.9–7.8 mm. long, 1.9–2.8 mm. wide; *keel* 8–10.3 mm. long, 0.8–2 mm. longer than the banner, the claws 2.7–3.5 mm., the oblong, subtruncate blades 5.6–7.3 mm. long, 2.5–3.2 mm. wide; *anthers* 0.45–0.6 mm., long; *stipe* of the pod 3–3.7 mm. long, the *body* narrowly ellipsoid, 8–12 mm. long, 2.5–4 mm. in diameter, often strongly decurved, the valves strigulose, delicately reticulate but not rugulose; *ovules* 6–8.—Collections: 10 (v); representative: *Holmgren 1316* (NY); *Train 996* (NA); *Ripley & Barneby 3612, 4003, 6265* (CAS, RSA), *9292* (CAS, RM, RSA).

Barren knolls, gullied hillsides, and desert sinks, in stiff white or red clays derived from limestone, with piñon, juniper, or sagebrush, 5000–7400 feet, locally abundant in scattered stations in the valleys and foothills of eastcentral Nevada (northwestern Nye, White Pine, Eureka, and probably southern Elko Counties).—Map No. 45.—May to July.

ASTRAGALUS BISULCATUS var. NEVADENSIS (Jones) Barneby in Leafl. West. Bot. 7: 195. 1954, based on *A. Haydenianus* var. *nevadensis* (of Nevada) Jones in Zoë 2: 241. 1891.—"Collected June 14, 1882, at Palisade, Nevada . . . distributed as "Astragalus n. sp." in my sets of 1882."—Holotypus, collected by M. E. Jones, POM! isotypi CAS, NY, RM, US!

Astragalus demissus (of low growth) Greene in Erythea 1: 221. 1893.—"Valley of the Humboldt River near Palisade, eastern Nevada, July, 1893."—Holotypus, collected by E. L. Greene, August 4, 1893, ND!—*A. Jepsoni* (Willis Linn Jepson, 1867–1946) Sheld. in Minn. Bot. Stud. 1: 22. 1894 *("jepsoni")*, a legitimate substitute (non *A. demissus* Bss., 1849). *Diholcos Jepsoni* (Sheld.) Rydb. in N. Amer. Fl. 24: 281. 1929.

The Nevada two-grooved milk-vetch, resembling var. *Haydenianus* in general habit of growth and in the small size of the flower and pod, is easily distinguished by the characteristically modified flower, few leaflets, and nearly smooth surface of the ripe pod. The sordid yellow petals and short bracts, though not of great importance as differential characters, add to the individuality of the variety, which occupies a small but compact area of dispersal disjunct from the rest of its species. Despite its likeness to var. *Haydenianus*, the var. *nevadensis* is probably derived independently from the so-called Basin Variants of var. *bisulcatus*, in particular the phase prevalent in southwestern Utah (*A. Haydenianus* var. *major*). The pods of these two forms are nearly identical in shape and reticulation, and relatively few (11–19) leaflets are a feature common to both. Broad, thin leaflets stressed as diagnostic of *D. Jepsoni* by Rydberg (1929, p. 281) are now known to be of rare and sporadic occurrence in the variety.

The var. *nevadensis* was first collected in 1865 by Dr. Torrey (NY, a *"grallator"* form), in "the East Range of the Humboldt Mountains," a station probably in Elko County, but too vaguely recorded to permit accurate mapping. The specimen may have been taken on bottomlands of Diamond Valley in northcentral Eureka County, where the Emigrant Trail from Fort Ruby to Austin passes close to stations where var. *nevadensis* is still abundant.

109. ASTRAGALUS RACEMOSUS

Coarse, leafy herbs of stout or moderate stature, with a woody taproot and knotty, multicipital root-crown at or just below soil-level, thinly to quite densely strigulose with filiform or flattened, appressed hairs up to 0.35–0.65 mm. long (rarely a few longer spreading ones up to 1 mm. long), the thick-textured herbage green or subglaucescent, sometimes cinereous in youth, the leaflets glabrous and often minutely papillate above; *stems* several or numerous, erect and ascending in clumps, (1.5) 2–6 dm. long, simple only when slender, more commonly branched or spurred at 1–6 nodes preceding the first peduncle, naked and usually hollow at base; *stipules* scarious or early becoming so, 3–12 mm. long, the lowest often broader than long, amplexicaul and connate into a short, subtruncate or bidentate, fragile, often early ruptured sheath, the median ones progressively less

united upward along the stem, the uppermost free or nearly so, with deltoid or triangular, spreading or deflexed blades; *leaves* (4) 5–15 cm. long, the lowest shortly petioled, the rest subsessile, with (9) 11–29 (31) lance-elliptic to ovate, mostly obtuse and mucronulate, sometimes (in upper leaves, rarely all) linear-lanceolate or -elliptic and acute or acuminate, flat or loosely folded leaflets (0.5) 1–3.5 cm. long; *peduncles* erect, commonly stout, (3) 4–11 cm. long, usually a little shorter than the leaf; *racemes* (15) 20–70-flowered, commonly dense (but sometimes quite loose) at early anthesis, the flowers nodding and ± retrorsely imbricated, the axis elongating, (3) 5–15 (22) cm. long in fruit; *bracts* scarious, lanceolate or lance-caudate, (1.5) 3–9 mm. long; *pedicels* slender, at anthesis straight and narrowly ascending to arcuately spreading, 2–3.5 mm. long, in fruit arched outward, decurved, or irregularly contorted, 3–8 mm. long; *bracteoles* 0–2; *calyx* 7.3–19 mm. long, pallid or rarely pinkish, finely strigulose with white, more rarely partly or wholly black hairs, the strongly oblique disc 0.9–1.5 mm. deep, the campanulate tube 4.7–9 mm. long, 3.2–5.5 mm. in diameter, the subulate or subulate-setaceous teeth 1.5–10 mm. long; *petals* white or ochroleucous (concolorous), or whitish with keel-tip, wings, or base and tip of banner-blade tinged or veined with pale lilac or pink-purple; *banner* recurved through ± 45° (or further in age), oblanceolate, with long-cuneate claw proximally incurved to conform with the oblique or gibbous base of the calyx, 14–20.5 mm. long, 6–10.5 mm. wide; *wings* 12.5–19 mm. long, the claws 5.2–8 mm., the narrowly oblong-oblanceolate, obtuse or obscurely emarginate, nearly straight or slightly incurved blades 9–12.4 mm. long, 2.2–3.7 mm. wide; *keel* 10.8–15.2 mm. long, the claws 4.7–8 mm., the lunately half-oblong-obovate blades 7.2–10 mm. long, 2.6–3.8 mm. wide, incurved through 85–95° to the rounded apex; *anthers* (0.6) 0.65–0.9 mm. long; *pod* pendulous, stipitate, the slender, straight stipe 3.5–7 mm. long, the linear-oblong, lance-oblong, oblong-ellipsoid, or (in one var.) plumply oblong-ovoid body 1–3 cm. long, 3–8 mm. in diameter, cuneate at both ends, or at base varying from acuminate to subtruncate, cuspidate at apex, straight or gently curved either way, triquetrously compressed with acute ventral and narrow but blunt lateral angles, the 3 faces all flat, or the dorsal face (or all 3) shallowly concave, the thin, pale green, glabrous or rarely thinly strigulose valves becoming papery, stramineous, lustrous, delicately cross-reticulate, not inflexed, or inflexed as a rudimentary partition less than 0.3 mm. wide; *ovules* 12–22; *seeds* dark or chestnut-brown, smooth or nearly so, dull or lustrous, 2.6–3.3 mm. long.

Key to the Varieties of A. racemosus

1. Body of the pod linear-oblong to narrowly oblong-ellipsoid, (1.5) 2–3 cm. long, 3–5.7 mm. in diameter; *leaflets* (11) 17–31; e. of the Continental Divide, Saskatchewan to Mexico (2)
   2. Calyx 7.3–9 (10.5) mm. long, its tube truncate at base, with pedicel inserted at the ventral corner, its teeth 1.5–3.5 mm. long; *leaflets* mostly narrow, elliptic or linear-elliptic; prairies, mostly below 4000 ft., Saskatchewan to Mexico ..... 109a. var. *racemosus*
   2. Calyx (9) 10–19 mm. long, its tube produced into a gibbous sac behind the insertion of the pedicel, its teeth (4.5) 5–10 mm. long: *leaflets* (at least of the lower leaves) broader, broadly elliptic to ovate-oblong; higher prairies, piedmont, and foothill canyons, mostly above 4000 ft., w. South Dakota to n.-w. New Mexico ..... 109b. var. *longisetus*
1. Body of the pod plumply oblong-ellipsoid or -ovoid, 1–2 cm. long, (4) 5–8 mm. in diameter; *leaflets* (9) 11–19; Green River and Uinta Basins, s.-w. Wyoming and n.-e. Utah ..... 109c. var. *Treleasei*

109a. Astragalus racemosus var. racemosus

Leaflets relatively narrow, the broadest on a plant 3–6 (8) mm. wide; *flowers* usually whitish, either concolorous or with lilac keel-tip, the wings and banner

sometimes pinkish-purple or purple-veined; *banner* 16–19 mm. long.—Collections: 70 (iv); representative: *J. Macoun 13,952* (ND); *C. L. Porter 3973* (RM, SMU, TEX); *Hapeman* (from Franklin, Nebraska) *in 1934, 1938, 1940* (CAS, NY, OKLA, WS); *Rydberg 70* (NY, WS); *Runyon 65* (CAS, OKLA, WIS); *Tharp 6328* (CAS, TEX); *McVaugh 7230* (NY, SMU).

Gullied bluffs, barren knolls, and alluvial bottomlands, on clay, shale or gypsum, 1700–4300 feet, locally abundant, southern Saskatchewan (local near Moose Jaw and on the headwaters of Qu'Appelle River) and North Dakota to western Oklahoma, the Texas Panhandle, and the Pecos Valley in eastern New Mexico, west just into eastern Wyoming and eastern Colorado, east to southeastern Nebraska and central Kansas; greatly isolated on dry lake beds at ± 6700 feet in western San Luis Potosí; reported from Minnesota (Fernald, 1950, p. 911, but no specimens at GH, MINN, or elsewhere).—Map No. 46.—May to July, flowering in late March southward.

ASTRAGALUS RACEMOSUS (with many flower-clusters) Pursh, Fl. Amer. Sept. 740. 1814.—"In Upper Louisiana. Bradbury."—Holotypus, labeled "Louisiana, Bradbury. Pursh's specimens," PH! isotypus, dated 1811–12, BM!—*A. galegoides* (resembling *Galega*, or goat's-rue) Nutt., Gen. 2: 100. 1818, technically an illegitimate substitute for the preceding. *Tragacantha racemosa* (Pursh) O. Kze., Rev. Gen. 947. 1891. *Tium racemosum* (Pursh) Rydb. in Bull. Torr. Club 32: 659. 1905. *A. racemosus* var. *typicus* C. L. Porter in Madroño 8: 99. 1945.

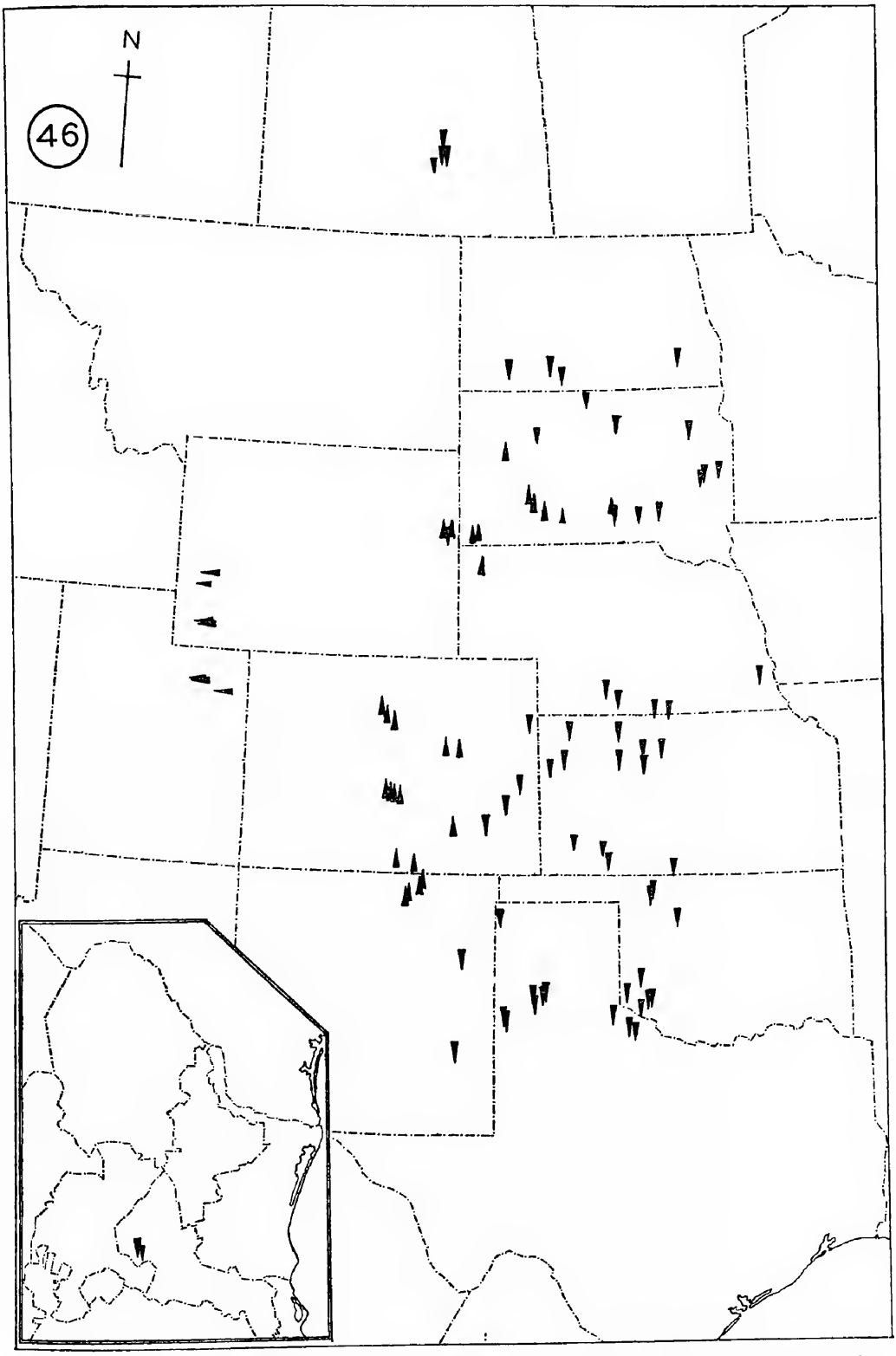
Astragalus racemosus var. *brevisetus* (with short bristles, in reference to the bracteoles) Jones in Proc. Calif. Acad. Sci. II, 5: 662. 1895.—"Ramos, Zacatecas, Mexico, May 5, 1892, Jones."—Holotypus, POM! isotypi, GH, NY, US!—Ramos is ± 40 miles e. of Ciudad Zacatecas within the state of San Luis Potosí.—*Tium brevisetum* (Jones) Rydb. in N. Amer. Fl. 24: 386. 1929.

The alkali milk-vetch, *A. racemosus,* is a handsome floriferous species, impossible to confuse with any astragalus of the Prairie States other than the white-flowered forms of *A. bisulcatus* and distinguished from these by its sharply three-angled and three-sided pod. It is particularly common along dry water courses and on banks of running streams and rivers, and is likely to be met with wherever an accident of the terrain or of erosion has exposed a seleniferous formation; and it becomes abundant where destruction of the sod has given rise to a badlands topography. It is thence carried down to the alluvial flats and bottomlands, but in such situations is less frequent and less vigorous than *A. bisulcatus.* Its primary natural habitat on the open prairie was apparently around calcareous or shaley outcrops.

The flowers of var. *racemosus* are ordinarily pure white or creamy white with pinkish or lilac keel-tip. In Kansas and Oklahoma, possibly elsewhere, it is common to find a color-form in which a blush of anthocyanin extends from the base of the banner-blade upward around its margins and into the wing-tips, or is concentrated into a purple keel-tip and a fan of reddish-purple veins in the fold of the banner. Possibly this color-form is commoner than has been realized, for the pigment fades rapidly in drying and disappears completely after a few months. The type-collection of var. *brevisetus,* according to Jones's field note (NY, POM), was such a form. Despite its remote origin at a point in Mexico over seven hundred miles south of the alkali milk-vetch's southernmost outposts in Texas or New Mexico, var. *brevisetus* cannot be distinguished from typical material from the United States. In the original publication Jones referred to his new variety, which he did not separate from typical *A. racemosus* in specific terms, specimens from the Cimarron Valley, Oklahoma (*Carleton 221,* NY, US) and from "Fremont," properly Frontier County, Nebraska (*Rydberg 70,* NY); and I agree that these are exactly conspecific. Rydberg maintained a purely Mexican *Tium brevisetum,* supposedly differing in its short calyx-teeth (1.5–2 as opposed to 2.5–4 mm. long) and thick-textured foliage, the latter being a feature characteristic of *A. racemosus* sens. lat. Only two collections of *A. racemosus* have been seen from south of the border, and the species was possibly introduced in San Luis Potosí.

109b. ASTRAGALUS RACEMOSUS var. LONGISETUS

Commonly more robust than var. *racemosus,* more amply leafy, the broadest leaflets of a plant 6–12 mm. wide; *calyx* pouched dorsally at base, with long, setaceous, or setaceous-tipped, often recurving teeth; *flowers* large, white, the banner 18–20.5 mm. long, the keel sometimes faintly maculate.—Collections: 30



Map No. 46. The Prairie States of United States and, inset, parts of northeastern Mexico. Range of *A. racemosus*: ▼ var. *racemosus*; ▲ var. *longisetus*; and ◆ var. *Treleasei*.

(iv); representative: *C. L. Porter 6919a* (NY); *Rydberg 620* (NY); *Rollins 1857* (CAS, NY, WS); *Ripley & Barneby 7236* (CAS, NY, RSA); *Eggleston 20,143* (CAS, NY).

Gullied clay bluffs, eroded shale barrens, and alluvial clay flats, especially common along creeks and rivers, locally abundant in the foothills of the southern Rocky Mountains and adjoining piedmont and higher prairies, 4500–6500 feet, in Colorado (Boulder County southward) and northern New Mexico (Colfax County); also at lower elevations, ± 3500–3800 feet, in the badlands and foothills of the Black Hills, South Dakota, and adjoining northwestern Nebraska, extending along the Cheyenne River just into eastern Wyoming, in this region passing into var. *racemosus*.—Map No. 46.—May to July.

ASTRAGALUS RACEMOSUS var. LONGISETUS (with long bristles, in reference to the hyaline bracts or bracteoles) Jones in Proc. Calif. Acad. Sci. II, 5: 663. 1895.—"... the types of this variety are in the National Herbarium. Wolf, No. 216, Apex, Colorado, June; Fort Collins, Colorado, on prairies; Sheldon, Pueblo, Colorado; Bodin and Eastwood, Denver, Colorado; Idaho, Hayden's Survey; Moose Jaw Creek... Macoun."—Lectotypus, collected at Pueblo, Colorado, June 8, 1890, *J. E. Bodin,* US! Paratypus, *Wolf 216,* US! The Sheldon and Hayden spms. at US represent *A. bisulcatus* and *A. racemosus* var. *racemosus* respectively; the Eastwood and Macoun spms. are at CAS and represent var. *longisetus* and var. *racemosus* respectively.

Tium platycarpum (with flat pod) Rydb. in N. Amer. Fl. 24: 387. 1929.—"Type collected along Oak Creek, Colorado, in 1873, *Brandegee.*"—Holotypus, NY!—*Astragalus platycarpus* (Rydb.) Barneby var. *typicus* Barneby in Leafl. West. Bot. 4: 59, Pl. 1, figs. 6, 27. 1944.

In the foothills of the Front Range in Colorado and southward interruptedly, where selenium-bearing formations are exposed, to the Arkansas Valley, the Mesa de Maya, and the sources of the Canadian in New Mexico, the var. *longisetus* is easily distinguished from the typical form of the alkali milk-vetch by its dorsally saccate, long-toothed calyx, consistently large flowers, and relatively ample leaflets. The bulk of Jones's material was of this type, so that even though long bracts (or bracteoles) are not diagnostic of the variety as redefined here, the choice of lectotypus seems justified. The populations of var. *longisetus* found in the Black Hills and badlands of South Dakota, like those of adjoining Wyoming and Nebraska, are for the most part less distinctive; and plants technically referable to var. *racemosus,* as well as var. *longisetus,* have been collected in the Cheyenne Valley in Niobrara County, Wyoming *(C. L. Porter 3973, 6919a).* Several collections from eastern Nebraska, and one notable one from Chaves County, New Mexico (*Waterfall 8749,* OKLA) have been identified and mapped as representing var. *racemosus,* but show various combinations of relatively long teeth (to 4–5 mm.) with narrow leaflets and truncate calyx, or short teeth with broad leaflets. The intermediate forms are perhaps too numerous, and reduction of the variety by Rydberg (1929, p. 387) and by C. L. Porter (1951, p. 11) was possibly justified.

At the time that I published the combination *A. platycarpus,* I had yet to learn of the variation in the flowers of *A. racemosus;* and I had not identified the type-locality of *Tium platycarpum,* which I believed might lie in southwestern Colorado, far outside the known range of *A. racemosus.* Oak Creek is a small tributary of the Arkansas River in Fremont County, where var. *longisetus* is especially common. The typus of *T. platycarpum* is fragmentary, lacking the diagnostic lower stipules of sect. *Bisulcati,* but there can be no reasonable doubt as to its identity.

109c. ASTRAGALUS RACEMOSUS var. TRELEASEI

Thinly strigulose or nearly glabrous; *stems* 2–4 dm. long; *leaflets* (9) 11–19, those of the upper leaves usually narrowly elliptic and sharply acute or acuminate; *calyx-tube* 5–6 mm. long, 3.4–4.5 mm. in diameter, gibbous-saccate behind the pedicel, the teeth 3.6–6 mm. long; petals ochroleucous with purplish keel-tip, the banner 14–16.5 mm., the keel 13–14 mm. long; *stipe* of the pod 4–6 mm. long, the body (10) 12–21 mm. long, (4) 5–8 mm. in diameter, broadly cuneate or subtruncately contracted at base.—Collections: 10 (vi); representative: *Rollins 1650* (NY); *C. L. Porter 5013* (NY, RM, SMU, TEX); *Ripley & Barneby 4678, 8744, 9947* (RSA).

Gullied shale or sandstone bluffs and along banks of desert washes and inter-

mittent streams, 5500–6800 feet, locally abundant in scattered stations on the floor of the Green River and Uinta Basins, southern Sublette and Uinta Counties, Wyoming, and Duchesne and Uintah Counties, Utah.—Map No. 46.—May to July.

ASTRAGALUS RACEMOSUS var. TRELEASEI (Sam Farlow Trelease, 1892–1958, from 1925 professor of botany at Columbia University, authority on selenium in plants) C. L. Porter in Madroño 8: 99, Pl. 9, figs. 1–3. 1945.—"Wyoming. Uinta County: between Carter and Lyman, spring of 1940, *O. A. Beath 125*."—Holotypus, RM! isotypi, GH, WTU!

Trealease's alkali milk-vetch is an extremely well-marked variety, distinguished by its relatively few leaflets and short, plumply proportioned fruit which is more abruptly contracted into the stipe than in other forms of *A. racemosus*. The calyx of var. *Treleasei* resembles that of var. *longisetus* in form and in length of the teeth, but the petals are shorter and the flower in consequence considerably less showy. I know the variety from only four mutually remote populations, two each in Wyoming (south of Big Piney; Black's Fork north of Lyman) and Utah (Strawberry River west of Duchesne; Willow Creek south of Ouray). The discontinuous distribution of var. *Treleasei*, which is not only remote from the main range of *A. racemosus*, but itself divided into two parts by the barrier of the Uintah Mountains, suggests comparatively great age and long isolation.

XXVIII. Sectio OOCALYCES

Stout, malodorous (selenium-scented), caulescent perennials, with superficial or very shallowly buried root-crown; *vesture* basifixed, below the inflorescence scanty; *stipules* dimorphic, the lowest connate, the rest free or nearly so; *leaves* imparipinnate, with ± 19–27 elongate, linear leaflets contracted at base into thick, decurrent petiolules; *racemes* densely many-flowered, the flowers subsessile, forming broadly cylindric heads, of moderate size, the banner 14–17 mm. long; *calyx* obliquely ovoid, accrescent and inflated, deciduous together with the small, enclosed pod; *petals* ochroleucous, regularly graduated, marcescent, the blade of the banner recurved through ± 45°; *pod* sessile but elevated on a short, stipelike gynophore, disjointing in age, oblong-ellipsoid, obcompressed, bisculate ventrally, the leathery valves not inflexed; *dehiscence* primarily basal, finally upward through the ventral suture, the escape-mechanism of the seeds not known; *ovules* 6–8.—Sp. 1, seleniferous xerophyte, of the upper San Juan Valley, southwestern Colorado and adjoining New Mexico.

ASTRAGALUS sect. OOCALYCES, sect. nov., floribus sessilibus, calyce urceolato inflato legumen parvum in gynophoro elevatum demum deciduum includenti prorsus singulares. Species unica habitu *Pectinatos*, legumine *Bisulcatos* (nisi deciduo) referens, ambobus affinis sed natura propria insignis.—Sp. typica: *A. oocalycis* Jones.

110. ASTRAGALUS OOCALYCIS

Commonly stout, with a woody, multicipital taproot, thinly strigulose with fine, straight, appressed hairs up to 0.5–0.75 mm. long, the herbage full-green or pallidly gray-green, the leaflets glabrous or nearly so above (but their elevated margins beset with a row of stiff hairs directed inward toward the midrib), the inflorescence silky-hirsute; *stems* erect and ascending in bushy clumps, (1.5) 2.5–4 dm. long, simple except for a rare spur from below the middle, composed of some 6–13 developed internodes, leafless at base, abruptly flexuous or zigzag distally; *stipules* scarious or early becoming so, 2.5–6 mm. long, the lowest amplexicaul and united into a bidentate sheath (this commonly ruptured by the expanding stem), the median and upper ones free or united by a narrow membrane or stipular line, with deltoid-acuminate, mostly reflexed blades; *leaves* 5–15 (17) cm. long, the lower ones shortly petioled, the rest subsessile, with (9) 19–27 linear or linear-oblong, acute, or obtuse and mucronulate, flat or commonly loosely inrolled, thick-textured leaflets (1) 2–4 cm. long; *peduncles* stout, erect, 9–17 cm. long; *racemes* spiciform, densely 35–60-flowered, broadly cylindric at full anthesis, the sub-

sessile flowers spreading and soon declined, the axis scarcely elongating, 4–8 (11) cm. long in fruit; *bracts* membranous, narrowly lanceolate, 3–8 mm. long, becoming papery and abruptly deflexed in fruit; *calyx* hirsute with straight, ascending and spreading hairs up to 1–1.5 mm. long, at early anthesis obliquely ovoid and 10–11 mm. long, the shallow disc 0.7–0.9 mm. deep, the tube early accrescent, at length papery and inflated, broadly ovoid to subglobose, up to 14 mm. long and 11 mm. in diameter, contracted at the mouth, the erect or connivent, triangular-subulate teeth 2–3 mm. long, the whole disjointing in age and falling with the ripe fruit; *petals* ochroleucous, marcescent; *banner* sigmoidally arched, the claw following the ventral curvature of the calyx, the whole broadly oblanceolate or obovate-cuneate, 14-17 mm. long, 6.4–7.6 mm. wide; *wings* 13–14.5 mm. long, the claws 6.3–7.6 mm., the oblong-oblanceolate or -elliptic, obtuse or emarginate, nearly straight blades ± 8 mm. long, 2.6–3.7 mm. wide; *keel* 11.2–13 mm. long, the claws 5.8–7.6 mm., the lunately half-elliptic blades ± 6 mm. long, 2.7–3.4 mm. wide, gently incurved through 45° to the rounded apex; *anthers* 0.7–0.85 mm. long; *pod* sessile on and ultimately disjointing from a slender, stipelike gynophore ± 1 mm. long, included within the calyx, the gynophore ascending and then abruptly bent at apex through nearly 90° (the pod-body therefore declined), the body oblong-ellipsoid, 6–7 mm. long, ± 3.5 mm. in diameter, rounded or subtruncate at base, abruptly cuspidate-beaked, straight or a trifle incurved, strongly obcompressed, with convex dorsal and openly grooved ventral faces, the sutures both prominent, the ventral one forming an elevated keel lengthwise within the shallow ventral sulcus, the thinly fleshy, glabrous valves becoming leathery, transversely rugulose-reticulate, not inflexed; *seeds* brown, smooth but dull, 2.8–3.4 mm. long.—Collections: 5 (i); representative: *Weber & Livingston 6233* (CAS, OKLA, SMU, TEX); *M. & G. Ownbey 3033* (NY, RSA, SMU, TEX, WS); *Ripley & Barneby 5334* (CAS, NY, RSA).

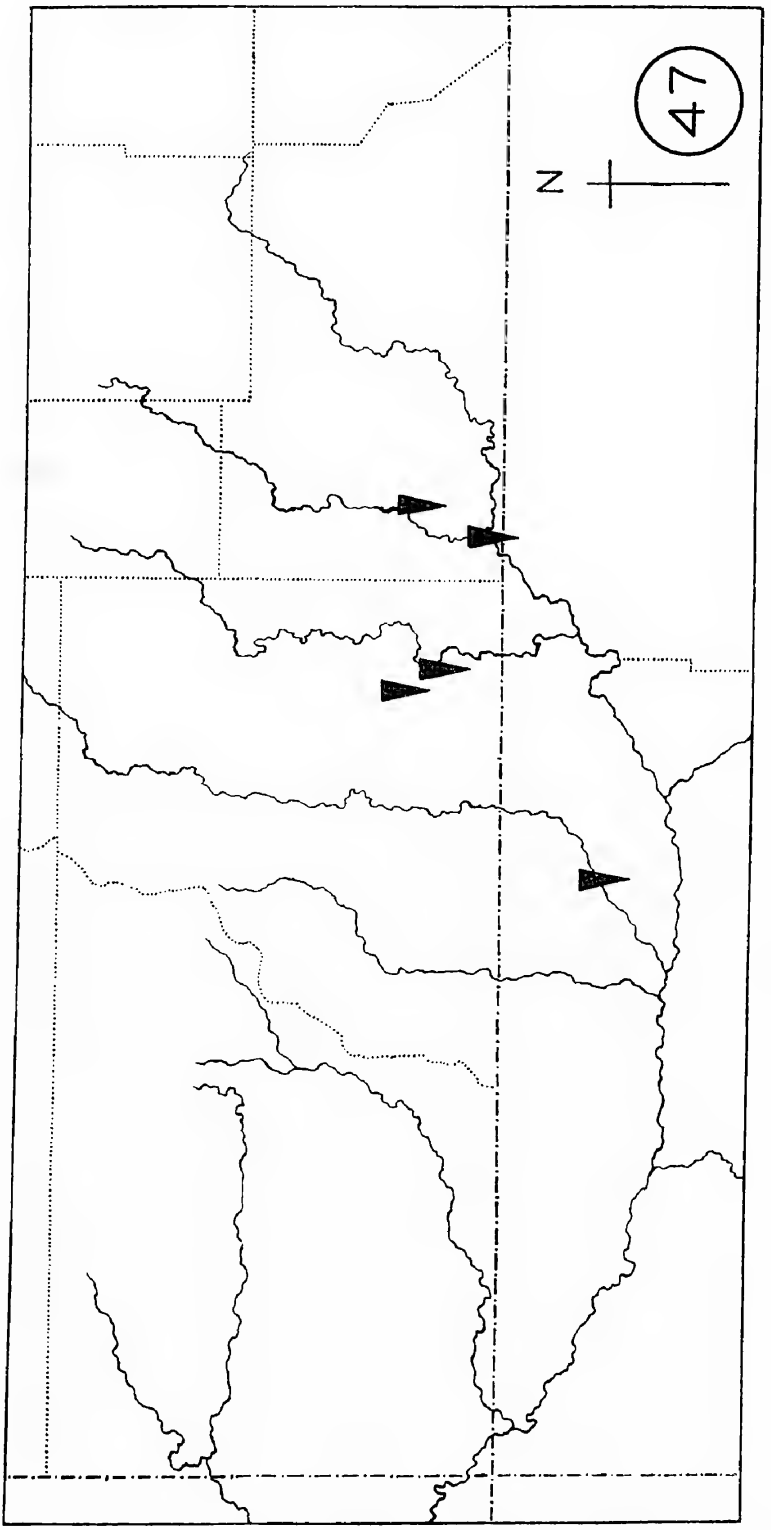
Dry knolls, gullied clay hillsides, gulches in sagebrush plains, and alluvial bottomlands, in stiff alkaline gumbo-clay soils, 5600–6700 feet, forming colonies but quite local, known only from a small area on and near the upper forks of the San Juan River in western Archuleta and adjoining La Plata Counties, Colorado, and northeastern San Juan County, Arizona.—Map No. 47.—May to July.

ASTRAGALUS OOCALYCIS (with egg-shaped calyx) Jones, Contrib. West. Bot. 8: 10. 1898.—"... on bottom lands at Aztec, New Mex. and communicated by Prof. Wooton."—Holotypus collected in July, 1895, POM!—*Diholcos oocalycis* (Jones) Rydb. in N. Amer. Fl. 24: 282. 1929.

Cnemidophacos urceolatus (shaped like a small pitcher, of the calyx) Rydb., Fl. Rocky Mts. 502. 1917.—"Mountains: Colo."—Holotypus, *C. F. Baker 424,* collected at Arboles, Colorado, June 3, 1899, NY! isotypi, G, GH, K, MO, ND, US!

By any standard of comparison, whether subjective and aesthetic or severely technical, the Arboles milk-vetch, *A. oocalycis,* is a remarkable astragalus. A vigorous, handsome plant, it combines the foliage of some *Pectinati* (but the long, stiff, pseudopetiolulate leaflets uncommonly numerous) with the small, ventrally bisulcate pod of *A. bisulcatus* var. *Haydenianus.* The pod differs, however, in being sessile on a gynophore and not truly stipitate as in the genuine *Bisulcati.* The most striking feature of the species is its subsessile, at length ovoid, and greatly inflated calyx, densely hirsute with cream-colored hairs, which is in contrast to the nearly glabrous foliage. Moreover the many crowded flowers are sessile or almost so, the inflorescence therefore becoming a massive, cylindro-oblong, spiciform head.

A calyx greatly inflated and finally accrescent so as to enclose a small, few-seeded pod has no match among American astragali, although there is some approach to this condition in sect. *Chaetodontes.* It is a rather common development in Asia, Bunge's two subgenera *Calycocystis* and *Calycophysa* being so characterized. The latter group has basifixed pubescence as in *Oocalyces,* but the claws of the inner petals are normally fused for a short distance with the staminal sheath. Undoubtedly, this modification of the calyx has occurred independently in the Arboles milk-vetch, of which the affinities, loosely speaking, have been apparent from the first. Jones aligned *A. oocalycis* with his *Bisulcati* (1923, p. 245), remarking that it "had the



Map No. 47. Headwaters of the San Juan River, southwestern Colorado and adjoining New Mexico. Range of *A. oocalycis*.

appearance of a sport, and the general look of *A. racemosus*," the species placed immediately after it in sect. *Galegiformes*. Rydberg first interpreted it as a *Cnemidophacos*, a genus which embraced our *Ocreati* and *Pectinati*, but following Jones he finally transferred it to *Diholcos* (= our *Bisulcati*), where it was maintained by Porter (1939). There has been a general agreement on the phyletic position of *A. oocalycis* among the seleniferous groups with connate stipules, an agreement which took form before its physiological adaptation to selenium was suspected; but if we assume that the species is derived from a common ancestry with the *Pectinati, Bisulcati, Albuli,* and *Ocreati*, we have no clue to its immediate precursor. It is tempting to suppose that the similarity in form of the pod-body between *A. oocalycis* and *A. bisulcatus* var. *Haydenianus* and the fact that these two poisonous vetches are found on the same shaley outcrops on the upper San Juan are causally related. But if *A. oocalycis* arose through hybridization involving var. *Haydenianus*, we have yet to find a sympatric second parent; and if by mutation directly from var. *Haydenianus*, we must admit that a mutation which involved so great a modification of the flower, and a simultaneous advance from an emmenoloboid to a piptoloboid fruit, gave rise in effect to an astragalus of a new and unprecedented type. So far as the fruit alone is concerned, *A. oocalycis* has more in common with *A. (Ocreati) flavus* than with the *Bisulcati*, but the foliage and flowers are very different. No species better deserves a monotypic section.

According to Jones (1923, Pl. 63) the pod of the Arboles milk-vetch varies from "almost sessile to long-stipitate," and the cited figure shows one apparently immature fruit already well exserted from the calyx and a cross-section distinguished by a pronounced lateral compression. No pod of this nature is now found on the type sheet, and it seems hardly possible that the fruit illustrated can have belonged to *A. oocalycis*.

XXIX. Sectio PECTINATI

Stout, malodorous (selenium-scented), caulescent perennials; *vesture* basifixed, often scanty; *stipules* all, or at least those at the lower nodes, connate-amplexicaul; *leaves* either imparipinnate, with ± 2–7 pairs of leaflets decurrent into the rachis or narowed at base into a pallid pseudopetiolule, or some (or all) reduced to the naked rachis; *flowers* racemose, either ascending or nodding at full anthesis, of medium or large size, the banner ± 1.5–3 cm. long; *pedicels* thickened in fruit, persistent; *calyx-tube* deeply campanulate or cylindric; *petals* white, ochroleucous, or pink-purple, regularly graduated, the keel-tip obtuse; *pod* erect, reflexed, or pendulous, sessile (in one sp. stipitate), persistent, a little dorsiventrally to very strongly laterally compressed, bicarinate by the thick, salient sutures, the fleshy valves becoming stiffly papery, leathery, or subligneous, not inflexed; *dehiscence* apical and downward through both sutures; *ovules* 12–32.

The *Pectinati* form one of the most sharply defined groups of North American *Astragali*, notable for the combination of connate stipules, decurrent leaflets of leathery texture, which release their moisture reluctantly in the press, thick-walled unilocular pods bicarinate at maturity by the salient sutures, and a physical adaptation to seleniferous soils. Nauseously malodorous, especially when bruised or when heated by the sun's rays, the plants are seldom grazed except by animals driven by extreme hunger or by perverse addiction; they are chiefly detrimental because they can contaminate the topsoil by converting selenium to water-soluble form which may be absorbed by otherwise palatable crops. With the exception of *A. pectinatus*, widely dispersed over the prairies, the *Pectinati* are comparatively rare denizens of desert badlands and are probably not of the first importance as locoweeds.

The affinities of the *Pectinati* are assumed to lie with the seleniferous *Bisculati*, which differ in their papery pods and jointed leaflets. In technical characters the section approaches, perhaps only through accidents of convergent evolution, the non-seleniferous sect. *Conjuncti* which also differs in its articulate lateral leaflets. The section was originally described to accommodate the one species known at the time, *A. pectinatus*, which also served as generitypus of the genus *Ctenophyllum* Rydb. The species discovered up to 1923 formed for Jones a subsection of his heterogeneous sect. *Podo-sclerocarpi*. Rydberg ultimately reduced *Ctenophyllum* to *Cnemidophacos*, the typus of which represents a separate group, also seleniferous, our sect. *Ocreati*. In common with sect. *Pectinati* the latter have connate stipules and unilocular fruits, but are easily distinguished by their jointed leaflets, shallowly campanulate calyx-tube, and pod dorsiventrally compressed and more or less bisculate ventrally. Within their section the *Pectinati* fall naturally into several subsidiary groups, but only one of these, the monotypic *Osterhoutiani*, seems sufficiently modified to deserve taxonomic rank.

Key to the Subsections of Sect. Pectinati

1. Pod either erect or deflexed, but always sessile, the body rarely more than 5 times longer than wide, terete or dorsiventrally compressed if the flowers white, though often laterally compressed if the flowers purple ..... XXIX (i). Subsect. *Pectinati*
1. Pod pendulous, long-stipitate, the linear-ellipsoid body 7–12 times longer than wide, strongly compressed laterally; *flower* white; local in Grand County, Colorado ..... XXIX (ii). Subsect. *Osterhoutiani*

XXIX (i) Subsectio Pectinati

Flowers pink-purple, ochroleucous, or white; *leaflets* linear or ± expanded; *pod* variably oriented and compressed, but always sessile.—Spp. 7, xerophytes, of the Great Plains and foothills of the Rocky Mountains from southern Canada to Kansas and Colorado, west through the Colorado Basin to northern and westcentral Nevada and to the Snake River Valley in southern Idaho and southeastern Oregon.

Astragalus sect. Pectinati Gray in Proc. Amer. Acad. 6: 221. 1864.—Sp. typica: *A. pectinatus* Dougl.—*Astragalus* sect. *Pectinatus* Sheld. in Minn. Bot. Stud. 1: 130. 1894, scarcely more than a substitute in substantival form for the preceding. *A.* sect. *Podo-sclerocarpi* subsect. *Pectinati* (Gray) Jones, Rev. Astrag. 142, in clave. 1923.

Ctenophyllum Rydb. in Bull. Torr. Club 32: 663. 1905.—Generitypus: *C. pectinatum* (Dougl.) Rydb. = *A. pectinatus* Dougl.

Key to the Species of Subsect. Pectinati

1. Flowers cream-colored, yellowish, or white; leaves all regularly pinnate, the leaflets of the upper leaves not reduced in size, or in number; e. of the Continental Divide except at ± 6400–7000 ft. in s.-w. Wyoming and immediately adjoining Utah (2)
   2. Stems commonly diffuse or ascending; *pod* deflexed; *ovules* 22–32 (3)
      3. Banner 21–24 mm. long; *calyx-tube* 2.8–4.3 mm. in diameter; *leaflets* linear-filiform, involute, rigid; widespread, but reaching its w. limit in s. Wyoming on the North Platte River in Carbon County ..... 111. *A. pectinatus*
      3. Banner 24–30 mm. long; *calyx-tube* 4.5–6.2 mm. in diameter; leaflets broader, linear-oblong or linear, not involute but with elevated margins, leathery but not rigid; local on and near the Red Desert, Sweetwater and s.-w. Fremont Counties, Wyoming, and adjoining Daggett County, Utah ..... 112. *A. Nelsonianus*
   2. Stems erect; *pod* erect; *ovules* 14–22 (23) ..... 113. *A. Grayi*
1. Flowers mostly pink-purple with white or pallid wing-tips, white only in *A. linifolius* very local in the lower Grand River Valley in Colorado at ± 5500 ft.; *leaves* all, or at least the upper ones, with leaflets much reduced in size, or number, or both, or absent, the plants in consequence of ± junceous or ephedroid appearance; intermountain U. S. (w. Colorado to n.-w. Nevada, s.-e. Oregon, and s. Idaho) (4)
   4. Pod (glabrous or strigulose) erect, narrowly ascending, or narrowly incurved-ascending; either local in w.-centr. Colorado (and the flowers then white) or widespread from n.-w. Utah w.- and n.-w.-ward (5)
      5. Petals pink-purple with whitish wing-tips; *racemes* 7–35-flowered; widespread from n.-w. Utah w. and n.-w.-ward ..... 114. *A. toanus*
      5. Petals white with purplish keel-tip; *racemes* 2–10-flowered; local in Mesa County, Colorado ..... 115. *A. linifolius*
   4. Pod (glabrous or strigulose) declined or deflexed; Colorado and Uinta Basins, centr. and n.-e. Utah (6)
      6. Stems glabrous or nearly so, subglaucescent, diffuse and ascending, 4–5.5 dm. long, the growing tips never cinereous; *pod* elliptic or oblong-elliptic in profile, 1.2–2.5 cm. long, 5–7.5 mm. in diameter, glabrous, the thickly fleshy valves becoming stiffly leathery or ligneous, longitudinally wrinkled, the terminal cusp 2.5–4 mm. long; San Rafael Swell and vicinity, Emery County ..... 116. *A. rafaelensis*
      6. Stems more or less strigulose, yellowish-green, erect, 1.5–3 dm. long, the growing tips commonly cinereous; *pod* linear-oblong or narrowly oblanceolate in profile, mostly 2-3 cm. long and 4.5–6 mm. in diameter, at least thinly strigulose, the valves of thinner texture, fleshy becoming stiffly papery, reticulate but not wrinkled, the terminal cusp 0.5–1 mm. long; Uinta Basin, Uintah County ..... 117. *A. saurinus*

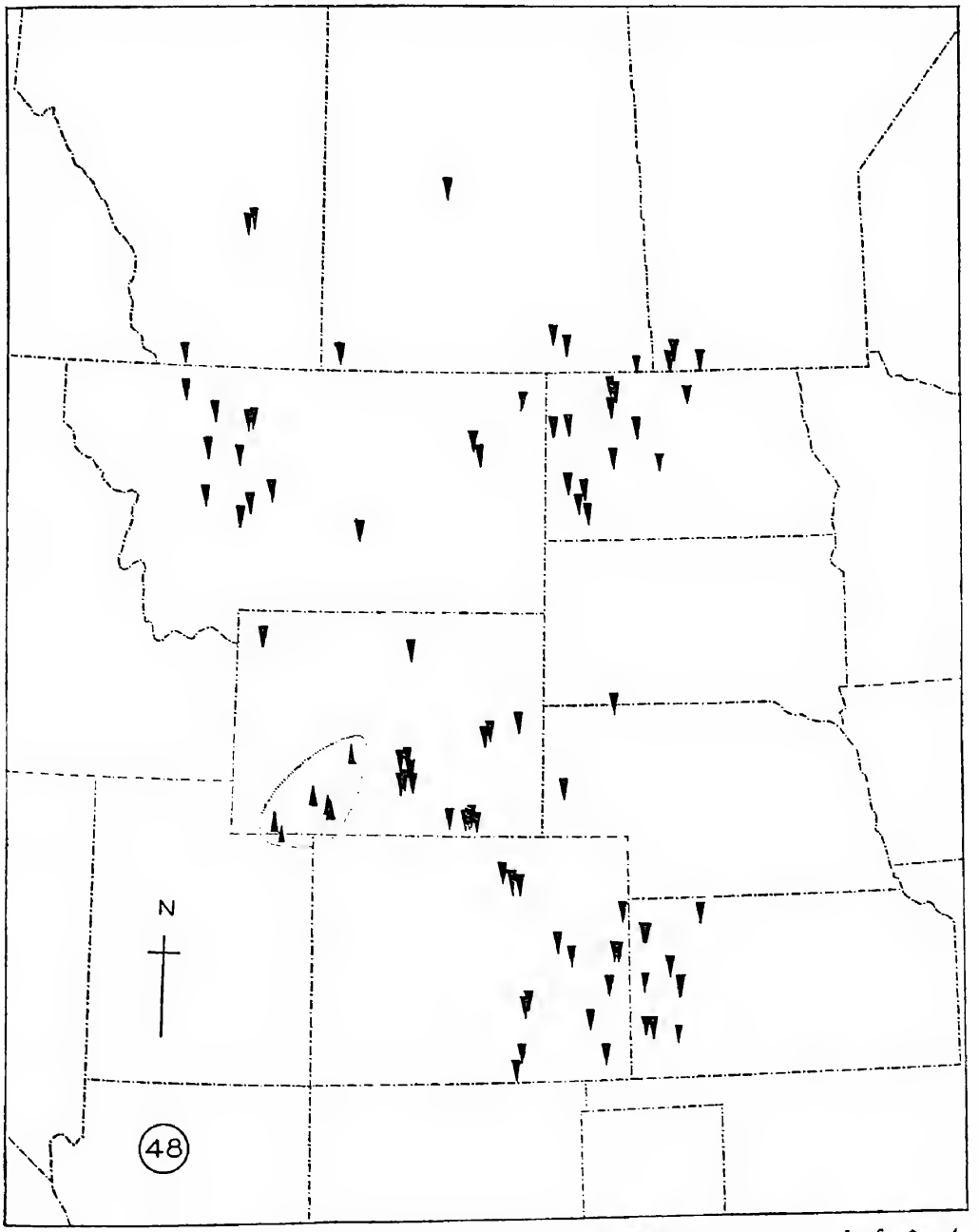
111. Astragalus pectinatus

Relatively coarse, diffuse, with a thick, woody taproot and pluricipital root-crown, strigulose nearly throughout with fine, appressed and narrowly ascending hairs up to 0.2–0.6 mm. long, the base of the stems, the upper surface of the leaflets, and the pod glabrous, the plentiful but stiff and narrow foliage pale gray-green, sometimes cinereous in youth; *stems* commonly stout, (1) 1.5–6 dm. long, decumbent or prostrate with ascending tips, forming depressed, bushy mats, diffusely and subpaniculately branched at or below the middle, rarely simple; *stipules* 1.5–10 mm. long, dimorphic, those at the lowest leafless nodes larger than the rest, amplexicaul and connate into a papery, shortly bidentate sheath, passing upward into shorter, herbaceous ones connate at base only or finally decurrent and free, the deltoid-acuminate blades commonly squarrose; *leaves* sessile or nearly so, 4–11 cm. long, with rigid, canaliculate, usually incurved rachis and (2) 4–7 (10) pairs of opposite or somewhat scattered, linear, filiform, or rarely linear-oblanceolate, involute and dorsally carinate, at length stiff and falcately incurved leaflets (7) 15–70 mm. long, sometimes narrowed at base into a short pseudopetiolule but not jointed, the lowest pair often longer than the rachis, the terminal one continuous with and similar in form to the rachis, mostly longer than the last lateral pair; *peduncles* stout, often incurved-ascending, (2) 3.5–8 (10.5) cm. long; *racemes* (7) 12–30-flowered, rather dense at early anthesis, the flowers at first ascending, later horizontal and finally declined, the axis elongating, 3–13 (17) cm. long in fruit; *bracts* herbaceous becoming papery, lanceolate or lance-acuminate, 2–7 mm. long; *pedicels* at anthesis 2–3 (3.5) mm. long, in fruit becoming thickened, rigid, arcuate or twisted and recurved, 2.5–5 mm. long; *bracetoles* usually 0; *calyx* 8–12 mm. long, strigulose with black, white, or mixed hairs, the oblique disc 1.1–2 mm. deep, the cylindric tube 6.5–9 mm. long, 2.8–4.3 mm. in diameter, the subulate or lanceolate teeth 1.5–3 mm. long, the whole becoming thinly scarious, ruptured, marcescent; *petals* ochroleucous, drying yellowish or cream-colored; *banner* gently recurved through 40–45°, 21–24 mm. long, the narrowly cuneate claw expanded into a lance-ovate, deeply notched blade 6.6–9.8 mm. wide; *wings* 17.7–19.5 mm. long, the claws 7.2–9 mm., the narrowly oblong-oblanceolate, obtuse, nearly straight blades 10.3–12 mm. long, (1.8) 2.7–3.4 mm. wide; *keel* 13.8–16 mm. long, the claws 7.9–9 mm., the lunately half-obovate or half-oval blades 6.3–7.5 mm. long, 3–3.5 mm. wide, gently incurved through 75–85 (90)° to the obtuse apex; *anthers* 0.7–0.85 (0.9) mm. long; *pod* declined or deflexed, sessile, plumply ellipsoid, or oblong- or rarely clavate-ellipsoid, straight or slightly decurved, (1) 1.5–2.5 cm. long, (4.5) 5–8 mm. in diameter, obtuse at base, abruptly contracted distally and long-cuspidate at apex, normally a trifle obcompressed and somewhat flattened dorsally but (when short) sometimes a little laterally compressed, both the sutures thick, salient, and cordlike, the ventral one 1–1.5 mm. wide, the dorsal one narrower, often sinuate, the green, fleshy, lustrous, glabrous valves becoming stiffly leathery or woody, stramineous or brownish, rugulose-reticulate, not inflexed; *ovules* (23) 26–32; *seeds* pale or pinkish-brown, smooth or minutely pitted, lustrous, 3–3.6 mm. long.—Collections: 81 (x); representative: *Moodie 909* (CAS, NY, TEX); *Macoun & Herriott 70,483* (ND, NY); *Hitchcock & Muhlick 11,891, 12,063* (NY, RSA, WS); *C. L. Porter 2861* (NY, WS, WTU), *4173* (NY, SMU, TEX); *M. Ownbey 1307* (NY, WS); *Ripley & Barneby 10,160* (CAS, RSA).

Alkaline clay or sandy flats, gullied bluffs, and low, barren hilltops, commonly in alluvial soils derived from shale outcrops, 1600–7800 feet, widely dispersed and locally common over the higher prairies and plains from southern Alberta to extreme southwestern Manitoba, south to the valley of the Arkansas

River in Kansas and the the Mesa de Mayo in Colorado (and to be expected in adjoining New Mexico), west in Montana to Glacier Park and the upper Missouri Valley and in Wyoming to Yellowstone Park and the valley of the North Platte; reported, probably in error, from Utah (Rydb., 1929, p. 288).—Map No. 48.—May to July, the fruit long persisting.

ASTRAGALUS PECTINATUS (comblike, from the stiff, tinelike leaflets) Dougl. ex G. Don, Gen. Hist. Dichl. Pl. 2: 257. 1832.—"Native of North America, in the pastures of the Saskatchewan."—Holotypus, formerly in herb. Lambert., not found at BM, but the description



Map No. 48. The Prairie States and Provinces. Range of ▼ *A. pectinatus*; and of ▲ *A. Nelsonianus*.

and following reference decisive.—*Phaca pectinata* (Dougl.) Hook., Fl. Bor.-Amer. 1: 141, tab. LIV. 1831. ("Pastures of the Saskatchewan, *Drummond*; and in the Red Deer and Eagle Hills, bordering on that river. *Douglas.*"—The Drummond and Douglas (dated 1827) collections are at K! The spm. at GH, labeled "*Phaca pectinata.* Oregon. Hooker. 1829." is presumably authentic also.—*Tragacantha pectinata* (Dougl.) O. Kze., Rev. Gen. 947. 1891. *Ctenophyllum pectinatum* (Dougl.) Rydb. in Bull. Torr. Club 32: 663. 1905. *Cnemidophacos pectinatus* (Dougl.) Rydb. in N. Amer. Fl. 24: 288. 1929.

The tine-leaved milk-vetch, *A. pectinatus,* is one of the most distinctive North American *Astragali.* Its leaves, composed of about four to seven or rarely ten pairs of extremely long, narrow, stiffly incurved leaflets, might be likened to those of *A. Kentrophyta* on a greatly enlarged scale but have no exact counterpart in the genus. Except for some inevitable variation in size of the flowers and in size and outline of the pods, *A. pectinatus* is a stable species and in spite of its wide dispersal, both in latitude and altitude, shows no signs of racial differentiation.

112. Astragalus Nelsonianus

Stout, malodorous, perennial, with a heavy, multicipital taproot and buried root-crown or caudex, the somewhat fleshy or leathery stems and herbage green or greenish-cinereous, thinly strigulose with fine, appressed hairs up to 0.4–0.8 mm. long, the leaflets glabrous or pubescent above, sometimes more densely hairy above than beneath; *stems* several or numerous, (1) 1.5–3 dm. long, decumbent and ascending in clumps, subterranean for a space of 2–10 cm., above ground either simple or bearing 1–2 branches or spurs near the middle, becoming flexuous distally; *stipules* 4–13 mm. long, dimorphic, those at the lowest leafless and first leafy nodes connate opposite the petiole into a papery, bidentate sheath, the median ones becoming herbaceous and progressively less connate upward, the uppermost connate at base only or nearly free, with lanceolate or deltoid-acuminate, often spreading blades; *leaves* (2.5) 4–9 cm. long, sessile or nearly so, with thick, grooved rachis and 2–4 (6) pairs of linear-oblong, obtuse or apiculate leaflets (1) 1.5–4.5 cm. long, up to (2) 3–5 mm. wide, narrowed at base into a short, pallid pseudopetiolule but not jointed, the margins elevated but the blade not involute, the terminal one similar to but often longer than the uppermost pair, tapering into and continuous with the rachis; *peduncles* stout, erect and incurved-ascending, 3–12 cm. long; *racemes* (6) 8–20-flowered, the flowers ascending, rather crowded in early anthesis, the axis early elongating, (2) 3–12 cm. long in fruit, the fading flowers and fruits recurved; *bracts* submembranous, lanceolate, pallid or purplish, 2.5–7 mm. long; *pedicels* at first ascending, straight, 1.5–3 mm. long, becoming recurved, thickened, up to 4 mm. long in fruit; *bracteoles* 2; *calyx* 10.2–14.5 mm. long, black-strigulose, the oblique disc 1.7–2.5 mm. deep, the broadly cylindric to deeply campanulate tube 7.2–10.2 mm. long, 4.5–6.2 mm. in diameter, the subulate or lanceolate teeth 2–4.5 mm. long, the whole becoming papery-scarious, irregularly circumscissile; *petals* clear white; *banner* recurved through ± 45°, 24–30 mm. long, the long-cuneate claw expanded into an ovate or lanceolate, notched blade 10–14 mm. wide; *wings* 21–26 mm. long, the claws 8–11.5 mm., the narrowly oblong-oblanceolate, obtuse or obscurely emarginate, nearly straight blades 13.6–16.8 mm. long, 3–5.4 mm. wide; *keel* 13.6–20.2 mm. long, the claws 8.2–11.4 mm., the half-obovate blades (7.7) 8–10 mm. long, 3.4–4.8 mm. wide, incurved through ± 90° to the rounded apex; *anthers* (0.7) 0.75–1.3 mm. long; *pod* deflexed, sessile, oblong-ellipsoid, 1.3–3.3 cm. long, 6–12 mm. in diameter, rounded or subtruncate at base, abruptly contracted at apex into a stout, erect cusp 1.5–4 mm. long, the body when first formed green, fleshy, subterete, becoming somewhat laterally or dorsiventrally compressed, bicarinate by the prominent, cordlike sutures, the lateral faces ± transversely distended, the glabrous or minutely puberulent valves becoming woody, rugulose, brownish-stramineous, not inflexed; *dehis-*

cence downward through both sutures; *ovules* (20) 22–28; *seeds* pale brown, smooth but dull, 3.6–4.1 mm. long.—Collections: 7 (ii); representative: *A. Nelson 7079* (K, MO, NY, POM, RM); *Porter & Rollins 5673* (GH, RM); *Ripley & Barneby 7919* (CAS, RSA); *Barneby 13,174* (CAS, GH, NY, RM, RSA, US).

Barren alkaline flats, gullied bluffs, and bottomlands, 6400–7000 feet, local but forming colonies on and just west of the Continental Divide in Sweetwater and adjoining Fremont Counties, Wyoming, and extreme northern Daggett County, Utah.—Map No. 48.—Late May to August, the fruit often persistent over winter on dead stems.

ASTRAGALUS NELSONIANUS (Aven Nelson, 1859–1952, long professor of botany at RM, author of the revised Coulter's Manual of Rocky Mountain Botany), stat. nov., based on *A. pectinatus* var. *platyphyllus* (with flat, broad leaflets) Jones, Contrib. West. Bot. **10**: 87. 1902. —"... collected by Pro. A. Nelson in Wyoming..."—Lectotypus, *A. Nelson 3115*, collected June 3, 1897, at Bitter Creek, Sweetwater County, POM! isotypi, MO, NY, RM, UTC! paratypi, *A. Nelson 4774* from the same locality, POM, RM!

At anthesis, on account of the relatively broad leaflets, the general aspect of *A. Nelsonianus* is that of a large-flowered *A. Grayi*, for which Rydberg mistook the isotypus of *A. pectinatus* var. *platyphyllus* at NY. The reflexed fruit, however, is almost exactly that of *A. pectinatus*, differing only in that it is usually plumper and reaches greater maximum length. The species is rather poorly distinguished from *A. pectinatus* by its ampler foliage, longer flower, and broader and more tumid calyx-tube. The petals of *A. pectinatus*, as I have seen them fresh in Wyoming, North Dakota, Colorado, and Kansas, are of a distinctly yellowish or ochroleucous color which becomes accentuated in drying; those of *A. Nelsonianus*, as observed near Bitter Creek and in the Uintah foothills near Manila, are pure, clear white and only assume a creamy cast in the press. The resemblance in foliage to *A. Grayi* and the size of the leaf-stomata suggest that *A. Nelsonianus* is polyploid or has polyploid populations.

113. ASTRAGALUS GRAYI

Usually robust and in the context of the section relatively leafy, with a thick, heavy taproot and shortly forking caudex at or just below soil-level, thinly strigulose throughout or nearly so with fine, sometimes flattened, appressed and narrowly ascending hairs up to 0.2–0.6 mm. long, the stems and leathery herbage dark yellowish-green, the leaflets glabrous or less often strigulose above; *stems* several or numerous, erect and ascending in clumps, (1.5) 2–3.5 dm. long, simple, or strictly branching at or below the middle; *stipules* firm, 2.5–10 mm. long, dimorphic, those at the leafless lower nodes amplexicaul and connate into a papery, bidentate sheath sometimes ruptured by the stem's expansion, the upper ones becoming more nearly herbaceous and progressively less connate upward, the uppermost deltoid-acuminate or caudate, free to the base or nearly so, the blades mostly squarrose; *leaves* (2.5) 4–10 cm. long, the upper ones subsessile, with stiff, grooved rachis and (1) 2–5 pairs of linear-oblong or oblanceolate, obtuse or subacute, conspicuously veined, flat but marginally elevated leaflets 1.5–5 (or in some early leaves only 0.6–1.5) cm. long, all or mostly contracted at base into a short, pallid pseudopetiolule but not jointed, the terminal one similar to but often longer than the last pair, tapering into and continuous with the rachis; *peduncles* erect, strict, 3–10 cm. long; *racemes* (5) 9–27-flowered, rather dense, the flowers ascending, the axis little elongating, (1) 1.5–7 cm. long in fruit; *bracts* firm, lanceolate, 2–7 mm. long; *pedicels* ascending, straight, at anthesis 0.7–2 mm., in fruit a little thickened, 1–3.5 mm. long; *bracteoles* commonly 2; *calyx* 6.5–10.3 mm. long, thinly to quite densely strigulose with white, rarely some or all black hairs, the slightly oblique disc 1–1.8 (2) mm. deep, the deeply campanulate to subcylindric tube 5.2–8 mm. long, 2.9–4.2 mm. in diameter, the lance-subulate teeth 1.2–2.5 mm. long, the ventral pair sometimes shorter, deltoid, the whole becoming scarious, investing the lower half of the pod; *petals* cream-colored, usually marcescent; *banner* recurved

through ± 40°, (14.5) 15–22.5 mm. long, roughly rhombic in outline, the long-cuneate claw expanded upward into an ovate, emarginate blade (6.2) 7–12 mm. wide; *wings* (14.4) 15–19.2 mm. long, the claws 7–8.7 mm., the oblong-oblanceolate, obtuse, nearly straight blades 8.2–12 mm. long, 2.2–3.2 mm. wide; *keel* (11.5) 12.7–15.2 mm. long, the claws (6.3) 7.3–8.7 mm., the half-obovate blades 5.8–7.3 mm. long, 2.7–3.2 mm. wide; *anthers* 0.7–0.85 mm. long; *pod* erect or ascending at a narrow angle, sessile, narrowly oblong or oblong-elliptic in profile, straight or nearly so, 9–18 mm. long, 2.7–3.5 mm. in diameter, obtuse at base, abruptly contracted and cuspidate at apex, terete or a trifle laterally compressed, carinate by the thickened, salient, cordlike ventral suture, the green, fleshy, glabrous or rarely strigulose valves becoming stiffly leathery, brownish-stramineous, coarsely reticulate, not inflexed; *ovules* (14) 16–21 (23); *seeds* olivaceous, minutely pitted, dull, 3–3.5 mm. long.—Collections: 11 (iv); representative: *C. L. Porter 5389, 5406* (CAS, NY, RM, TEX); *E. Nelson 4866* (NY); *Ripley & Barneby 8006* (CAS, NY, RSA, UTC); *Barneby 13,217* (CAS, NY, RSA).

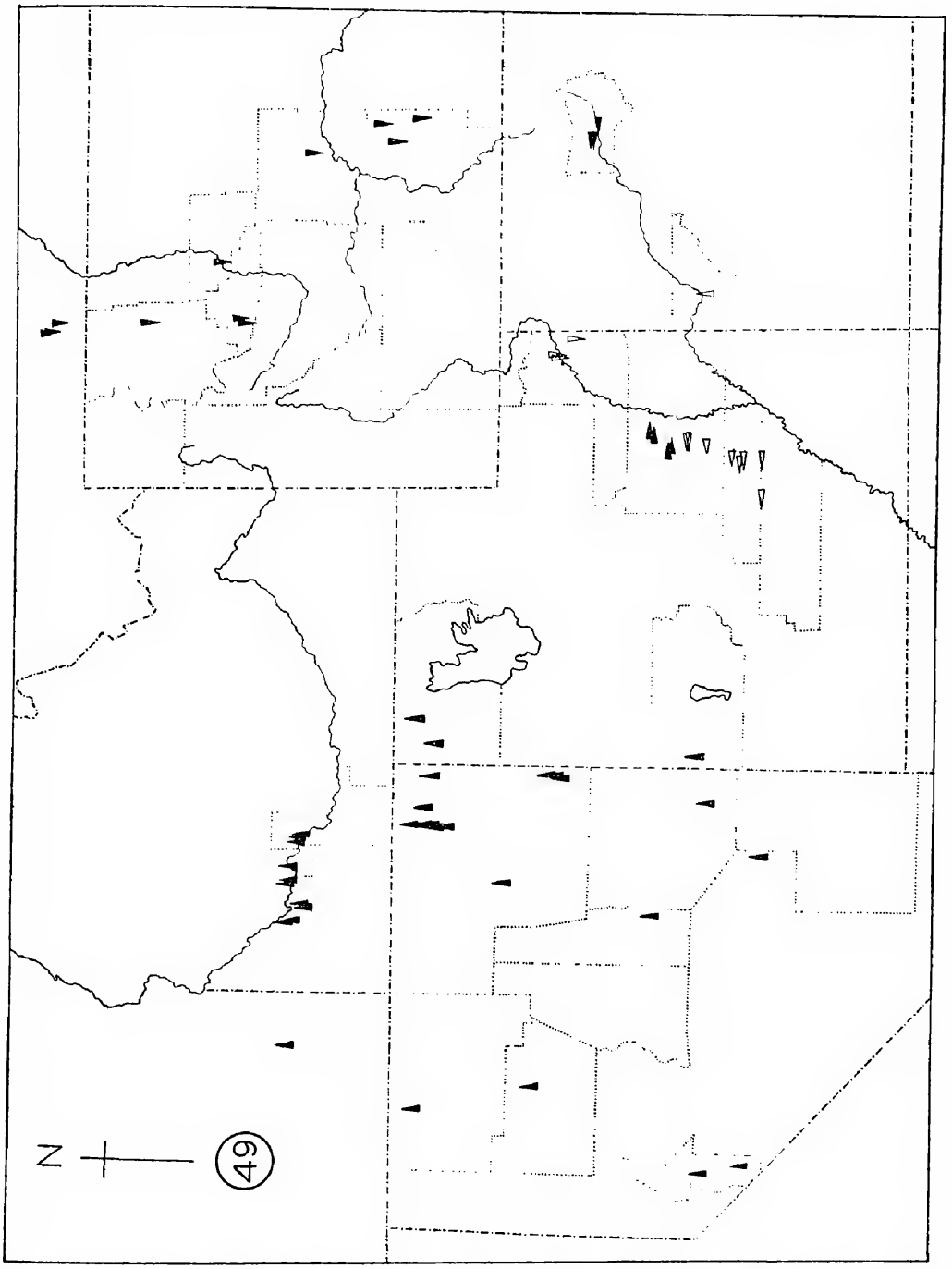
Forming extensive colonies on adobe plains, on ridges of gullied clay hills and badlands, or in sandy pockets about shale and sandstone outcrops, 3850–7000 feet, locally plentiful on the upper forks of the Big Horn, Powder, and North Platte Rivers, from southeastern Carbon County, Montana, southeast to the Medicine Bow River in Carbon County, Wyoming.—Map No. 49.—May to July, the fruit long persisting.

ASTRAGALUS GRAYI (Asa Gray, 1810–1888) Parry ex Wats. ap. Parry in Amer. Nat. 8: 212. 1894.—"On the gravelly ridges bordering Owl Creek valley."—Holotypus, *Parry* 75a, collected on the Northwest Wyoming Expedition in 1873 at Owl Creek, Washakie County, Wyoming, GH! isotypi, G, K, NY, P, PH!—*Tragacantha Grayi* (Parry) O. Kze., Rev. Gen. 945. 1891. *Ctenophyllum Grayi* (Parry) Rydb. in Bull. Torr. Club 40: 50. 1913. *Cnemidophacos Grayi* (Parry) Rydb. in N. Amer. Fl. 24: 287. 1929.

Gray's milk-vetch combines the foliage and whitish (though smaller) flower of *A. Nelsonianus* with the erect stems and erect pods of *A. toanus;* it thus connects the pale-flowered, more foliose *Pectinati* of the east continental slope with the largely purple-flowered, ephedroid species of the intermountain deserts. The flower of *A. Grayi* varies considerably in size, the variation being apparently sporadic and not correlated with a recognizable pattern of dispersal. The petals of *A. Grayi* are no more firmly attached to the rim of the floral disc than those of related species, but they persist about the forming pod, fastened there by the tightly investing calyx which does not fall away by circumscissile fission. As a consequence, the fruiting raceme has a characteristically untidy appearance. Rydberg (1929, 1. c.) described the pod as 4–5 mm. in diameter, but I have seen none so plumply oblong. The concept of *Cnemidophacos Grayi* as described in *North American Flora* was based partly on material of *A. Nelsonianus;* this may account for the discrepancy. Gray's milk-vetch is reportedly tetraploid, with $2n = 44$.

114. ASTRAGALUS TOANUS

Commonly robust, sparsely leafy and junceous, with a thick, woody, multicipital taproot and knotty crown or shortly forking caudex just below soil-level, strigulose nearly throughout with flattened, appressed and subappressed hairs up to 0.2–0.6 mm. long, the young shoots commonly cinereous, the stems and herbage greenish or thinly cinereous at maturity, occasionally green and nearly glabrous, the leaflets either glabrous or pubescent above; *stems* numerous, erect and ascending in bushy clumps, (1.5) 2.5–5 dm. long, leafless at base, simple or paniculately branched at and below the middle; *stipules* 1.5–6.5 mm. long, dimorphic, the lowest amplexicaul and connate into a papery-scarious, truncate or obtusely bidentate sheath (sometimes ruptured by the enlarging stem), the upper ones smaller, herbaceous, ovate or deltoid-acuminate, about semiamplexicaul, free; *leaves* 2.5–10 cm. long, with stiff, channelled petiole and rachis, the lower ones bearing 1–4 (6) pairs of distant, irregularly inserted, linear-filiform or rarely



Map No. 49. Utah and parts of Nevada, Idaho, Wyoming, and Colorado. Range of ◆ *A. toanus*; of ◇ *A. saurinus*; of ◗ *A. rafaelensis*; of ⌓ *A. linifolius*; of ▼ *A. Grayi*; of ◖ *A. Osterhoutii*; and of ◊ *A. Woodruffii*.

linear-oblong, obtuse or subacute, involute leaflets 3–30 mm. long decurrent into the rachis, the terminal one appearing as a linear, often falcately recurved prolongation of the rachis longer than the last lateral pair, or all leaves, and nearly always the uppermost, reduced to a linear phyllode devoid of leaflets; *peduncles*

stout, strict, 6–25 cm. long; *racemes* loosely 7–35-flowered, the flowers ascending, the axis (1.5) 3–30 cm. long in fruit; *bracts* herbaceous becoming papery, ovate or lanceolate, 1–2 (3) mm. long; *pedicels* ascending, straight, at anthesis 0.8–2 mm., in fruit greatly thickened, 2–3.5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 4.6–7.3 mm. long, densely strigulose with white, black and white, or rarely almost all black hairs, the oblique disc (0.6) 0.9–1.5 mm. deep, the campanulate or subcylindric, ventrally convex tube 4.1–6.1 mm. long, (2.6) 3–3.9 mm. in diameter, the deltoid or lanceolate teeth 0.5–2 mm. long, the ventral pair often shortest and broadest, the whole becoming scarious, ruptured, marcescent; *petals* bright pink-purple, the wing-tips paler or white; *banner* recurved through 40–45°, rhombic-ovate, or with long-cuneate claw abruptly expanded into an oval-ovate blade, (13) 15–20 mm. long, 7.8–10 mm. wide; *wings* (11.6) 13.5–17 mm. long, the claws (4.2) 5.2–7 mm., the narrowly lance-oblong or oblanceolate, obtuse or subemarginate, nearly straight blades (7.9) 8.6–11 mm. long, 1.5–2.9 mm. wide; *keel* (9.5) 10.5–13.5 mm. long, the claws (4.3) 5.2–7 mm., the half-obovate or lunately half-elliptic blades 5.2–7.2 mm. long, 2.5–3.1 mm. wide, incurved through 50–80 (90)° to the rounded, sometimes obscurely porrect apex; *anthers* 0.55–0.7 mm. long; *pod* erect or exceptionally spreading and ascending, sessile, elliptic, narrowly oblong, or oblong-elliptic in profile, straight or a trifle incurved, (1) 1.3–2.5 cm. long, 3.7–5.5 (7) mm. in diameter, obtuse at base, cuneately or subtruncately contracted distally, stiffly cuspidate at apex, a trifle laterally compressed, bicarinate by the salient, thick and cordlike sutures, the faces convex, the fleshy, green or sometimes purple-speckled, lustrous valves becoming stramineous, leathery or subligneous, rugulose-reticulate, varying from glabrous to minutely puberulent or sometimes densely strigulose-cinereous, not inflexed; *ovules* (14) 16–26; *seeds* smooth, brown, 2.9–3.8 mm. long.—Collections: 43 (viii); representative: *Train 3681* (NA, NY, TEX); *Maguire & Holmgren 22,026* (NA, NY, WS), *22,240* (NY), *26,244* (NY, RSA, TEX, WS); *Ripley & Barneby 6472* (CAS, NY, RSA), *9940* (RSA, UTC); *Leiberg 2031* (NY, ORE); *Alexander & Kellogg 5324* (US).

Barren, calcareous clay banks, sandy shale or clay bluffs and knolls, sometimes on gumbo-clay flats with *Atriplex* and *Sarcobatus,* 2500–5900 feet, of scattered occurrence but forming extensive colonies where selenium-rich soils are available, plentiful in eastcentral and northeastern Nevada, especially in the upper Humboldt Valley, and extending just east into northwestern Utah; again plentiful along the Snake and lower Bruneau Rivers in Idaho, and extending just into Malheur County, Oregon; occasionally westward in Nevada to the Humboldt Sink, the Quinn River, and the lower Walker River in Lyon County, and south to the sink of the White River in northeastern Nye County.—Map No. 49.—May to July.

ASTRAGALUS TOANUS (of the Toano Mountains) Jones in Zoë 3: 296. 1893 ("Toanus"). —". . . on the slopes of the Toano Range, Eastern Nevada, in open ground . . . out of flower July 21, 1891."—Lectotypus, a fruiting plant labeled "Ferguson Spring, Nevada, near Deep Creek," POM! isotypus, labeled "Toano Range," US! probable isotypi, dated July 24, 1891, GH, K!—*Cnemidophacos toanus* (Jones) Rydb. in N. Amer. Fl. 24: 287. 1929.

Astragalus campylophyllus (with curved leaves) Greene in Pittonia 3: 195. 1897.—"Sandy deserts of the lower Humboldt River, Nevada, near the Humboldt House, collected by the writer, in leaf and fruit only, 22 July, 1894."—Lectotypus, *Herb. Greene No. 34,509,* the one sheet of three so labeled bearing pubescent pods as described, ND!

The Toano milk-vetch is the prototype of a group of *Pectinati* adapted to desert or semi-desert conditions and distinguished by greatly modified foliage and so-called junceous or ephedroid habit of growth. In this and the three species next in order the leaves are composed of few, small, irregularly inserted leaflets; and some of them, either high on the stems or nearly throughout the plant, are reduced to a slender, tapering rachis which resembles a branchlet

except for the channeled upper side. They differ further from the *Pectinati* described up to this point (but see a possible exception in *A. linifolius*) in their pink-purple and not white or ochroleucous flowers. The modification of the foliage is of the sort achieved also by several *Lonchocarpi, Genistoidei,* and *Hookeriani* of the intermountain states; but all of the latter have papery pods and most of them a much more shallowly campanulate calyx. Of its immediate group, *A. toanus* is the commonest and most widely dispersed, but is absent from the Colorado and Uinta Basins to which its three close relatives are endemic.

The typical form of *A. toanus,* as seen about the sources of the Humbolt in northeastern Nevada, has relatively large flowers and consistently glabrous fruits. Along the Snake River in Idaho, the petals and calyx are ordinarily a little smaller, and the pod is commonly pubescent, at least sparsely so and often strigulose-cinereous. However in Gooding County, between Bliss and King Hill, there is an enclave of glabrous-fruiting populations which cannot be effectively separated from the Nevadan form. Furthermore, the type-collection of *A. campylophyllus,* from Humboldt County, Nevada, consists of three sheets and includes plants with glabrous and others with cinereously pubescent fruits. Very likely the two sorts in this collection are samples of different populations, but even so the two forms must occur close together in the Humboldt Desert. There seems no rational basis for segregating either a small-flowered or a pubescent-fruiting phase.

When past flowering, the Toano milk-vetch forms broomlike, apparently leafless tufts of stiffly fastigiate outline, identifiable into late summer by the pods which remain long on the desiccating stems, their valves bent outward in a widely gaping dehiscence and soon emptied of their seeds. Because of the sparseness of the foliage and the freedom with which the loose spikes of comparatively large, richly colored flowers are produced after a rainy spring, a flourishing colony of *A. toanus* provides a spectacle of color hardly matched in its bleak habitat of barren knolls rising out of the sagebrush desert.

115. Astragalus linifolius

Junceous, apparently leafless perennial, closely resembling *A. toanus* in habit, the growing tips and inflorescence thinly strigulose with appressed and subappressed hairs up to 0.5–0.6 mm. long, the stems yellowish-green; *stems* ± 3.5–4 dm. long, shortly subterranean at base, bearing 1–2 branches well below the middle, abruptly flexuous distally; *stipules* dimorphic, the lowest papery-membranous, several-nerved. 3.5–5 mm. long, connate-amplexicaul into a bidentate sheath, the upper ones 2.5–4 mm. long, herbaceous, connate at base only, with triangular-subulate, erect or deflexed blades, all glabrous dorsally; *leaves* (3) 4–12 cm. long, mostly reduced to the naked rachis, some lower ones bearing near the middle a single pair of obovate or linear-involute, decurrent leaflets 2–12 mm. long; *peduncles* stout, erect (appearing like a continuation of the stem), 1–2.5 dm. long; *racemes* loosely or remotely 6–10-flowered, the uppermost ones 2–3-flowered, the flowers ascending, the axis early elongating, (1.5) 3–9 cm. long in fruit; *bracts* pallid but firm, prominently nerved, triangular-subulate, 2–3 mm. long; *pedicels* ascending, at anthesis 0.5–2 mm., in fruit thickened, 1.5–3.5 mm. long; *bracteoles* 1–2, sometimes subobsolete; *calyx* 6.6–7.8 mm. long, white-strigulose, the disc ± 1.5 mm. deep, the campanulate tube 5–5.2 mm. long, 3.7–3.8 mm. in diameter, the subulate teeth 1.4–2.8 mm. long, the whole becoming papery-membranous, fragile but marcescent; *petals,* according to Osterhout's field note, "white, the keel with a small purple tip"; *banner* recurved through ± 45°, broadly rhombic in outline, 14.6–18 mm. long, 9–9.5 mm. wide; *wings* 12.4–16.5 mm. long, the claws 4.7–6.3 mm., the linear-oblanceolate, obtuse, almost straight blades 8.4–11.2 mm. long, 2.6–3.2 mm. wide; *keel* 11.3–12.3 mm. long, the claws 5.3–6.2 mm., the lunately half-elliptic blades ± 6.5 mm. long, 3.1 mm. wide, incurved through ± 80° to the bluntly triangular apex; *anthers* 0.6–0.7 mm. long; *pod* erect, sessile, narrowly oblong-ellipsoid, nearly straight, 1.2–1.7 cm. long, 4.5–6 mm. in diameter, broadly cuneate at base, abruptly contracted at apex into a rigid, subulate cusp 1.5–2 mm. long, a trifle laterally compressed, bicarinate by the thickened, salient sutures, the faces convexly rounded, the fleshy, green, glabrous valves becoming ligneous, stramineous, cross-reticulate and wrinkled lengthwise, not inflexed; *dehiscence* apical and half-way down through

both sutures; *ovules* 18–20; *seeds* not seen.—Collections: 2 (o); representative: *Osterhout* (from the type-station) *in 1921* (NY, RM).

Low gullied hills, ± 4700–5000 feet, known only from the type-locality in the Grand River Valley near Grand Junction, Mesa County, Colorado.—Map No. 49. —May and June.

ASTRAGALUS LINIFOLIUS (flax-leaved, but probably intended to mean linear-leaved) Osterh. in Bull. Torr. Club 55: 75. 1928.—"Collected on the hills some six miles across the Colorado River from Grand Junction, 18 June 1926; *no. 6557.*"—Holotypus, RM! isotypi, GH, NY, POM!—*Ctenophyllum linifolium* Osterh., l.c., nom. nud. in syn.

The Grand Junction milk-vetch, *A. linifolius,* is so poorly known that reflections on its taxonomic status have little value. The species was reduced by Rydberg (1929, p. 287) to *A. rafaelensis,* but it seems to be at least varietally distinct in its somewhat smaller, erect pod, longer calyx-teeth, and whitish petals. It resembles *A. toanus* in the upright fruit and was reduced to it by C. L. Porter (1951, p. 31), but the comparatively few-flowered racemes and once again the whitish petals are different. For phytogeographic reasons a closer relationship would be expected between *A. linifolius* and *A. rafaelensis,* both native to sandstone areas at low elevations in the Colorado Basin, than between either of these and the distantly allopatric *A. toanus,* a species of the Great Basin which reaches its eastern known limit in Utah west of Great Salt Lake. The fruits of the three entities are essentially alike in form, and possibly they represent no more than three phases of a single, discontinuously dispersed species. Material of *A. linifolius* in vigorous young flowering condition is needed before the racial situation can be clarified.

116. ASTRAGALUS RAFAELENSIS

Stout, coarse, apparently leafless and junceous, with a heavy, trunklike, multicipital taproot, glabrous except for a few scattered, appressed hairs up to 0.2 mm. long about the extremities of the stems, young shoots, pedicels, and calyces, the whole plant dull gray-green or commonly subglaucescent; *stems* many, diffuse and ascending in bushy clumps of rounded outline, 4–5.5 dm. long, simple or nearly so; *stipules* papery-scarious or early becoming so, 1–5 mm. long, the lowest longer than the rest, fully amplexicaul and connate into a subtruncate or shortly bidentate sheath opposite the suppressed petiole, the median and upper ones progressively shorter and less strongly connate, the uppermost deltoid, connate at base only or united by a stipular line; *leaves* (2.5) 4–12 cm. long, nearly all reduced to the naked, filiform, channelled rachis tapering upward into an acute, often falcately recurved tip, a few of the lowest ones bearing 1–2 pairs of distant, linear-filiform, involute, decurrent leaflets 3–20 mm. long; *peduncles* stout, erect, 1–3 dm. long; *racemes* loosely 5–12-flowered, the flowers at first ascending, spreading in age, the axis 2–10 (15) cm. long in fruit; *bracts* scarious, ovate or lanceolate, 1.2–3.5 mm. long; *pedicels* at anthesis about 2 mm. long, in fruit thickened, arched outward, 2.8–5.5 mm. long; *bracteoles* 2; *calyx* 6–6.2 mm. long, thinly strigulose with white or some black hairs, or the tube glabrous and only the teeth ciliate, the oblique disc 0.9–1.5 mm. deep, the deeply campanulate tube 5.2–5.5 mm. long, 3.6 mm. in diameter, the triangular-subulate or deltoid teeth about 0.8 mm. long, the whole becoming scarious, ruptured, persistent; *petals* pink-purple, the wing-tips paler or white; *banner* gently recurved through about 40°, broadly rhombic-oblanceolate, retuse, about 17.3 mm. long, 8.4–8.8 mm. wide; *wings* 14.4–15.7 mm. long, the claws 6.3–6.7 mm., the lance-oblong, obtuse, nearly straight blades 8.8–10 mm. long, 2.8–2.9 mm. wide; *keel* 12.2–13 mm. long, the claws 6.3–6.8 mm., the lunately half-elliptic blades 6.1–6.5 mm. long, about 2.8 mm. wide, incurved through 60–75° to the triangular apex; *anthers* 0.6–0.75 mm. long; *pod* decurved, sessile, broadly elliptic to narrowly oblong-elliptic in profile, (1.2) 1.4–2.5 cm. long, 5–7.5 mm. in diameter, straight and subsymmetric or a trifle decurved (the ventral suture then more strongly convex than the dorsal), obtuse at base, abruptly

acute and stiffly cuspidate at apex, the stout, subulate cusp 2.5–4 mm. long, the body laterally compressed, with convex sides, bicarinate by the stout, salient, cord-like sutures, the green, fleshy, glabrous valves becoming stiffly leathery or subligneous, stramineous, rugulose-reticulate and wrinkled lengthwise, not inflexed; *ovules* 18–20; *seeds* greenish-brown, angled and minutely pitted, 3.4–4.2 mm. long. —Collections: 5 (ii); representative: *Ripley & Barneby 4720* (CAS, RSA), *8676* (CAS, RSA, UTC); *B. F. Harrison 8086* (US).

Forming colonies on the banks of sandy clay gulches, in pockets at the foot of sandstone outcrops, or among boulders along dry watercourses, 4500–5300 feet, rare and local in and around the San Rafael Swell, on the San Rafael and Price Rivers, Emery County, Utah. Map No. 49.—May and June.

ASTRAGALUS RAFAELENSIS (of San Rafael Swell) Jones, Rev. Astrag. 146, Pl. 30. 1923 (*"Rafaelensis"*).—"... near Cedar Mt. Utah which is near Woodside, 4500 ft. alt.... May 19, 1915..."—Holotypus, collected by M. E. Jones, POM (3 sheets)! isotypi, CAS, GH, NY (2 sheets), PH, UTC!—*Cnemidophacos rafaelensis* (Jones) Rydb. in N. Amer. Fl. 24: 287. 1929 (pro parte, exclus. syn. *A. linifolio*).

The San Rafael milk-vetch is closely related to *A. toanus*, but differs in several characters other than the deflexed pod emphasized in the sectional key. The more diffuse growth-habit, the more pronouncedly rushlike stems which are essentially glabrous and subglaucescent when fresh, and the almost complete absence of lateral leaflets in most leaves denote a more extreme state of xerophytic modification. I know the species only from the Price River Valley near Woodside and from the crossing of the San Rafael River in the heart of the Swell, but the plants are locally abundant in both these localities.

117. ASTRAGALUS SAURINUS

Robust, sparsely leafy and somewhat junceous, with a stout, woody root and closely forking caudex or knotty root-crown just below soil-level, strigulose nearly throughout with fine, straight, appressed, together with a few ascending or spreading (sometimes partly black) hairs up to 0.5–0.8 mm. long, the stems and herbage yellowish-green or the growing tips cinereous, the leaflets pubescent above; *stems* several or very numerous, erect and stiffly ascending in well-furnished clumps, (1.5) 2–3 dm. long, leafless at base, spurred or slenderly branched at 1–3 nodes preceding the first peduncle, the branches strictly ascending; *stipules* dimorphic, those at the lowest, leafless, congested nodes 2.5–7 mm. long, connate into a pallid, papery-scarious, several-nerved, truncate or shortly bidentate sheath, the median and upper ones smaller, 1.2–5 mm. long, herbaceous with scarious margins, becoming papery, triangular-ovate or lanceolate, either semi-amplexicaul or joined opposite the petiole by a low collar or stipular line; *leaves* (2.5) 3–9 cm. long, the lower ones with 1–4 distant pairs of linear, linear-oblanceolate, or filiform, obtuse or subacute, involute leaflets 1–2.5 cm. long, either confluent with the rachis or obscurely pseudopetiolulate, the uppermost ones (or sometimes nearly all) reduced to the naked rachis, the terminal leaflet always confluent, longer than the last pair of lateral ones; *peduncles* stout, erect, 7–17 cm. long; *racemes* loosely but shortly (4) 6–14-flowered, the flowers at first ascending but early declined, the axis little elongating, (1) 2–6 cm. long in fruit; *bracts* submembranous becoming papery, triangular-ovate or broadly lanceolate, 1.2–2 mm. long; *pedicels* 1.5–2.5 mm. long, at anthesis ascending or a trifle arched outward, in fruit thickened, arcuate-recurved, but scarcely longer; *bracteoles* 1–2, minute; *calyx* (6.4) 7–9.6 mm. long, densely and rather loosely strigulose with white commonly mixed with black or fuscous hairs, the somewhat oblique disc 1.2–1.6 mm. deep, the campanulate, purplish tube 5.6–6.7 mm. long, 2.8–5.2 mm. in diameter, the broadly subulate to triangular-subulate teeth (0.9) 1.2–3.6 mm. long, the ventral pair often longest and widest, the whole becoming

papery-scarious, ruptured or not, marcescent; *petals* bicolored, bright pink-purple (drying bluish) with white wing-tips; *banner* recurved through ± 50° (or further in withering), broadly rhombic-oblanceolate or elongately rhombic-obovate, deeply notched, 18–22 mm. long, 9–13 mm. wide; *wings* 14.5–20 mm. long, the claws 5.9–8.9 mm., the linear-oblong, or oblanceolate, obtuse, nearly straight blades 9.8–14 mm. long, 2.7–4 mm. wide; *keel* 12–16 mm. long, the claws 6–8.3 mm., the lunately half-elliptic blades 6.2–8.3 mm. long, 2.9–4.2 mm. wide, incurved through 85–90° to the obtuse apex; *anthers* (0.6) 0.65–0.9 (1) mm. long; *pod* deflexed, sessile or contracted at base into an obscure, stipelike neck up to 1 mm. long and as broad, linear-oblong or narrowly oblanceolate in profile, straight or very slightly incurved, (1.5) 2–3.4 cm. long, 4.4–6 mm. in diameter, cuneately contracted or tapering at base, abruptly contracted distally and shortly cuspidate (the cusp 0.5–1 mm. long), strongly compressed laterally, bicarinate by the prominent sutures, the faces low-convex, the green, thinly fleshy, densely to quite thinly strigulose or glabrescent valves becoming stiffly papery, stramineous, prominently reticulate, not inflexed; *ovules* 19–29; *seeds* greenish or greenish-brown, commonly red- or purple-spotted, smooth or sparsely pitted, scarcely lustrous, 3.2–4 mm. long.—Collections: 10 (ii); representative: *Wolf & Deaver 5005* (CAS, DS, TEX, US); *Ripley & Barneby 12,714* (CAS, GH, NY, POM, UTC, US), *12,716* (CAS, K, NY, RM, UTC, WS).

Canyon benches and saddles or draws of gullied badlands, in sandy clay soils derived from weathered sandstones, 4850–5400 feet, local but forming colonies, known only from the Green River Valley near the floor of the Uinta Basin in eastcentral Uintah County, Utah.—Map No. 49.—Late April to July.

ASTRAGALUS SAURINUS (of lizards, i.e., of Dinosaur National Monument) Barneby in Leafl. West. Bot. 8: 17. 1956.—"UTAH: ... Dinosaur National Monument, 6 miles north of Jensen, 26 June, 1953, *A. H. Holmgren & S. S. Tillett 9527* ..."—Holotypus, NY! isotypi, CAS, DAV, MO, RSA, US!

In early flower the Dinosaur milk-vetch is equally as handsome and floriferous as the closely related *A. toanus* with which it has almost everything in common up to the early declined, but similarly proportioned flowers and the deflexed pod of perceptibly thinner texture. Care should be taken to distinguish it from the superficially similar (because junceous and purple-flowered) *A. (Lonchocarpi) Coltoni* in which the pod is narrowed at base into a long filiform stipe; this is as yet unknown from north of Tavaputs Escarpment. The species resembles *A. rafaelensis* in the orientation of the fruit but, as shown in the sectional key, is more easily distinguished by other characters than from *A. toanus*. The range of *A. saurinus* extends from Dinosaur Monument, where it is common around the headquarters, to Raven Ridge on the road south from Jensen to Bonanza, a distance of some twenty-five miles. The species is to be sought and expected in the White River Valley in western Rio Blanco County, Colorado, which offers mile upon mile of apparently suitable terrain.

XXIX (ii). Subsectio OSTERHOUTIANI

Flowers white; *leaflets* linear-oblong or oblanceolate, or in the uppermost leaves filiform, but always present; *pod* pendulous, stipitate, the linear-ellipsoid body strongly compressed laterally.—Sp. 1, xerophyte, of the upper Grand River Valley, Colorado.

ASTRAGALUS sect. PECTINATI subsect. OSTERHOUTIANI, subsect. nov., a *Pectinatis* veris legumine elongato angusto maxime compresso stipitato facile separati. Folia fere *A. Grayi*, flores declinati albi fere *A. pectinati* affinitatem cum *Pectinatis* seleniferis, nec *Lonchocarpis* ob legumen stipitatum comparandis praebent.—Sp. unica: *A. Osterhouti* Jones.

118. ASTRAGALUS OSTERHOUTI

Stout and coarse, with a heavy, multicipital taproot, appearing almost glabrous, but the extremities of the stems, the lower surface of the upper leaves, and the inflorescence thinly strigulose with fine, sometimes flattened, appressed and

narrowly ascending hairs up to 0.2–0.5 mm. long, the stems and herbage somewhat succulent, dark green; *stems* several or numerous, erect and ascending from the root-crown or shortly forking, shallowly buried caudex in dense bushy clumps, 2.5–4.5 dm. long, simple or few-branched, leafless at base, hollow and commonly zigzag distally; *stipules* 2–8 mm. long, dimorphic, those at the lowest (leafless) and sometimes the first leafy nodes the longest, connate into a scarious, subtruncate or shortly bidentate sheath, the median and upper ones shorter, becoming upwardly more nearly or quite herbaceous and progressively less connate, the uppermost deltoid or deltoid-acuminate, connate only at the very base, united by a stipular line, or free; *leaves* 3–8.5 cm. long, subsessile, with (5) 7–15 linear-oblong or oblanceolate, or (in the uppermost leaves) sometimes filiform, obtuse leaflets (0.6) 1–4 cm. long, not involute but with elevated margins, mostly narrowed at base into a short, pallid pseudopetiolule but not jointed, the terminal one decurrent into the rachis; *peduncles* stout, erect, (6) 8–14 cm. long, 1–3 from the upper axils, often appearing subterminal; *racemes* loosely 12–25-flowered, the flowers early spreading horizontally and then declined, the axis (2.5) 4.5–10 cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–3.5 mm. long; *pedicels* at anthesis 2.5–5 mm. long, in fruit arcuate-recurved, not greatly thickened, 3–6 mm. long; *bracteoles* usually 1–2, minute; *calyx* 8.5–12 mm. long, strigulose with black or mixed black and white hairs, the oblique disc 0.8–1.6 mm. deep, the cylindro-campanulate or cylindric tube 7–10 mm. long, 3.5–4.7 mm. in diameter, strongly convex ventrally, the triangular-subulate teeth 0.8–2 mm. long, the ventral pair sometimes broadest and deltoid, all approximate on the lower side of the calyx, the ventral sinus thus very broad and deeply cut back, the orifice oblique, the whole becoming scarious, marcescent unruptured; *petals* white; *banner* gently recurved through 40–45°, 17–23.5 mm. long, the narrow, long-cuneate claw expanded into a lance-ovate or ovate, shallowly retuse blade 8.2–11.5 mm. wide; *wings* 16–21.3 mm. long, the claws 7.3–9.3 mm., the oblong-oblanceolate, obtuse, nearly straight blades 9.5–13 mm. long, 3–3.6 mm. wide; *keel* 12.3–14.8 mm. long, the claws 7.3–8.6 mm., the half-obovate blades 5.7–6.8 mm. long, 3–3.7 mm. wide, rather abruptly incurved through 85–95° to the obtuse, deltoid or triangular, sometimes obscurely porrect apex; *anthers* 0.7–0.85 (0.9) mm. long; *pod* pendulous, stipitate, the stipe 2–6.5 mm. long, the linear-ellipsoid body 2.5–4.5 cm. long, 3–4 mm. in diameter, straight or gently incurved either way, tapering at both ends, cuspidate at apex, strongly compressed laterally, bicarinate by the prominent sutures, low-convex on the faces, the fleshy, glabrous, shining green valves becoming stiffly papery, greenish-stramineous, reticulate but not rugulose, not inflexed; *ovules* 12–17, rarely 7–8; *seeds* brown, smooth but scarcely lustrous, 3.2–4 mm. long.—Collections: 5 (i); representative; *W. A. Weber 4914* (SMU, TEX, WS), *4915* (CAS, SMU, TEX, WS); *Ripley & Barneby 10,516* (CAS, NY, RSA, RM).

Forming colonies along gulches in denuded clay hills, on barren knolls, and at the foot of gullied bluffs, in stiff alkaline clay or shaley clay soils, sometimes growing up through sagebrush, 7500–7700 feet, very local, known only from the valley of the upper Grand River and affluent creeks in Grand County, Colorado (near Hot Sulphur Springs; north of Kremmling).—Map No. 49.—June to August.

ASTRAGALUS OSTERHOUTI (George Everett Osterhout, 1858–1937, active in n. Colorado from 1893 onward) Jones, Rev. Astrag. 251, Pl. 64. 1923.—"Sulphur Springs, Grand Co., Colorado. Nos. 3038 and 3235, July [17], 1905 and June [9], 1906, Geo. E. Osterhout."—Cotypi, from "about 4 miles below Sulphur Springs," POM! isotypi, NY, RM!—*Lonchophaca Osterhouti* (Jones) Rydb. in N. Amer. Fl. **24**: 313. 1929 *("Osterhoutii").*

The Osterhout milk-vetch closely resembles *A. Grayi* and *A. Nelsonianus* of the genuine *Pectinati* in almost all technical characters up to the fruit, which is stipitate, greatly elongate, and strongly compressed, a modification which surely entitles it to its monotypic subsection. Nevertheless there can be little doubt that the three species are derived from a common precursor already obligately adapted to soils rich in selenium. Jones described *A. Osterhouti* as a certain member of sect. *Lonchocarpi,* where connate stipules would be, inter alia, an anomaly. Rydberg (1929, p. 313) concurred in this judgment, even though the compression of the fruit is at variance with the generic character of *Lonchophaca.* The unique features of *A. Osterhouti* were first appreciated by Porter (1949, p. 35) who provided for it a separate but unnamed group among the seleniferous species. It was first recognized as seleniferous by Beath (in Amer. Jour. Bot. 26: 729. 1939).

Like several other *Pectinati* already described, the Osterhout milk-vetch is very local, its known range being restricted to an area not much over fifteen miles in diameter. The dependence of these species on selenium does not explain their extreme localization, for apparently suitable habitats are available close to flourishing colonies, and some seleniferous astragali are dispersed over immense areas.

XXX. Sectio WOODRUFFIANI

Stout, caulescent perennial, malodorous and probably seleniferous, with a taproot and buried root-crown; *vesture* basifixed, but some hairs attached just above the lower end; *stipules* large, dimorphic, the lowest united behind the petiole into a sheath, amplexicaul but free or nearly so, the upper ones foliaceous, cauline; *leaves* short and sparse, with 1–3 (4) pairs of small, remote, decurrent leaflets, the terminal one elongate and continuous with the rachis; *flowers* racemose, ascending, of moderate size, the banner ± 12–18 mm. long; *pedicels* tardily disjointing with the fruit; *calyx-tube* deeply campanulate, prominently 5-nerved in fruit; *petals* pink-purple with pale or white wing-tips, regularly graduated, the keel-tip obtuse; *pod* erect, sessile, persistent on the receptacle, narrowly oblong in profile, nearly straight or lunately incurved, strongly flattened laterally, unilocular, the thinly fleshy valves becoming stiffly papery; *dehiscence* apical and halfway down through both sutures, the valves gaping; *ovules* (10) 12–20.

ASTRAGALUS sect. WOODRUFFIANI, sect. nov., affinitatis dubiae, sect. *Pectinatis* forsan proxima sed stipulis magnis herbaceis subdimorphis, imis post petiolum suppressum in vaginam bidentatam coadunatis (nec vero connatis), pilisque nonnullis supra basin affixis cito distincta. Herba robusta adspectu proprio, subaphylla, pube densa cinereo-canescens, racemis multifloris post anthesin laxis, legumine coriaceo erecto anguste oblongo valde compresso suturis bicarinato uniloculari.—Sp. unica: *A. Woodruffi* Jones.

On account of its greatly compressed, two-sided, unilocular pod the Woodruff milk-vetch, a rare and singular monotype, was assigned by Jones to his sect. *Homalobi* and by Rydberg (1929, p. 264) to the homonymous genus, where it was associated with the junceous *A. (Lonchocarpi) lancearius* in sect. *Tenelli.* It differs from all genuine *Lonchocarpi* in its erect fruit and incipiently dolabriform vesture and from typical *Tenelli* (= our sect. *Ervoidei*) even more gravely in stipular and floral characters. Jones (ex char.) described the plants as having a strong snakelike odor, a term which he used repeatedly for the malodorous, selenium-converting species. This was true also of the material that I collected. While I cannot be sure without chemical experiment that *A. Woodruffi* is seleniferous, there is presumptive evidence that such is the case, and this is in harmony with what can be assumed from exterior morphology about the probable affinities of the species. In nearly all systematically important features *A. Woodruffi* compares favorably with the sparsely leafy, purple-flowered *Pectinati* of the Great and Colorado Basins, differing from these collectively in the very large, firm stipules, the lowest of which are not truly connate (or only very shortly and obscurely so) but united behind the rudimentary or suppressed petiole into a cauline sheath. The species is evidently quite isolated in the genus, and its monotypic section is introduced at this point in the belief that *A. Woodruffi* probably arose from a common precursor with the *Pectinati.* The pod and its dehiscence are essentially like those of *A. (Pectinati) toanus,* although the pedicels disjoint more readily in age.

119. ASTRAGALUS WOODRUFFI

Coarse, malodorous, sparsely leafy and broomlike, with a stout taproot and closely forking caudex buried in sand, densely strigulose-pilose with shorter, ap-

pressed and often flattened together with longer, narrowly ascending, straight or nearly straight hairs up to 1–1.25 (1.4) mm. long (these all basifixed or some of them attached laterally just above the lower end), the stems and herbage silvery-silky or greenish-cinereous, the leaflets (when present) pubescent on both sides; *stems* several or numerous, erect and ascending in well-furnished clumps, 3–5.5 (6.5) dm. long, simple and subterranean for a space of 6–10 cm., branched from the first emersed up to the first floriferous axil and the branches again branched or spurred (the spurs sometimes paired with a peduncle distally), the main branches stiffly and strictly ascending; *stipules* large and conspicuous, the lowest ones firmly papery, pallid, 1–2.5 cm. long, united behind the subobsolete petiole into a semi- or fully amplexicaul, many-nerved, obtusely bidentate sheath (when fully amplexicaul sometimes very briefly connate), the median and upper ones foliaceous, ovate, obovate, or lanceolate, obtuse or acute, 0.5–1.5 (2.5) cm. long, broader than the contiguous pair of leaflets, embracing half or much less than half the stem's circumference, pubescent dorsally; *leaves* 1.5–6.5 cm. long, shorter than or equaling the internodes, with short or subobsolete petiole and 1–7 (9) distant, mostly irregularly inserted, linear, linear-oblong, or filiform, closely folded leaflets 2–17 mm. long, the terminal one elongate, all decurrent into the rachis; *peduncles* stout, strictly ascending or erect, (3.5) 5–16 cm. long, much surpassing the leaf; *racemes* (8) 10–45-flowered, rather dense in early anthesis, the flowers ascending, the axis early and often greatly elongating, 2–25 (30) cm. long in fruit; *bracts* herbaceous or firmly papery, lanceolate, 2.5–7 mm. long, silky dorsally; *pedicels* straight, narrowly ascending, at anthesis 1–2.7 mm., in fruit somewhat thickened, 1.5–5 mm. long; *bracteoles* commonly 2, minute or up to 3.5 mm. long, sometimes 0; *calyx* 7.2–10.9 mm. long, densely silky-pilosulous with white hairs, the subsymmetric disc 1–2 mm. deep, the deeply campanulate tube 4.2–6.6 mm. long, 3–4 mm. in diameter, the rather firm, lanceolate teeth (2.7) 3–6 mm. long, the whole becoming papery, prominently 5-nerved, marcescent unruptured; *petals* bright pink-purple, the banner with a pale, striate eye, the wing-tips paler or white; *banner* recurved through 35–45°, rhombic-obovate to broadly oblanceolate, shallowly notched, 11.7–18.3 mm. long, 6–9 mm. wide; *wings* 11–17.5 mm. long, the claws 4.9–7 mm., the narrowly oblong-elliptic or -oblanceolate, obtuse and erose or obscurely emarginate, slightly incurved blades 7–11.6 mm. long, 2.1–3 mm. wide; *keel* 9.4–14.3 mm. long, the claws 4.8–7.8 mm., the lunately half-obovate or -elliptic blades 5–7.4 mm. long, 2.5–3 mm. wide, gently incurved through 80–90° to the blunt apex; *anthers* 0.5–0.65 mm. long; *pod* erect, sessile, narrowly oblong in profile, straight or gently incurved, 1.4–2 cm. long, 3.5–4.8 mm. in diameter, rounded at base, cuspidate at apex, strongly compressed and 2-sided, bicarinate by the salient sutures, the thinly fleshy, densely strigulose valves becoming stramineous and stiffly papery, not inflexed; *seeds* narrowly oblong, green or purplish-green, ± pitted or wrinkled, 4.6–5.3 cm. long.—Collections: 10 (iii); representative: *Maguire 18,207* (UTC), *18,156* (WTU); *B. F. Harrison 11,173* (BRY, RSA, US); *Barneby 13,138* (CAS, NY, RSA, US), *13,143* (CAS, NY, RSA).

Dunes and dunelike talus at the foot of sand bluffs or sandstone outcrops and escarpments, 4300–5300 feet, local but forming extensive colonies, known only from the east side of the Colorado Basin in Emery, Wayne and eastern Garfield Counties, Utah.—Map No. 49.—May to July.

ASTRAGALUS WOODRUFFI (Robert Woodruff, companion to Jones on trips into the deserts of central Utah) Jones, Rev. Astrag. 77, Pl. 4. 1923.—"On the sandy foot of the San Rafael Swell."—Cotypi, collected by M. E. Jones on May 17 and 18, 1914, POM! isotypi, CAS, GH, NY, PH, RM, US, UTC, WS, WTU!—*Homalobus Woodruffi* (Jones) Rydb. in N. Amer. Fl. 24: 264. 1929.

The Woodruff milk-vetch is easily recognized among other desert astragali with foliage greatly reduced and consequent broomlike growth-habit by its silvery-cinereous vesture, very large, veiny stipules, numerous ascending, loosely racemose flowers of moderate size, and erect, two-sided, unilocular legume. The plants flower prolifically, and *A. Woodruffi* was described by Jones (l.c.) as being "the most beautiful species of the genus when the whole mass is ablaze with pink-purple bloom."

XXXI. Sectio MISELLI

Caulescent perennials, with superficial root-crown or caudex; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with 11–17 leaflets; *flowers* loosely (in *A. agnicidus* densely) racemose, spreading or declined at full anthesis, small or medium-sized, the banner 5–16.5 mm. long; *calyx-tube* campanulate; *petals* white, ochroleucous, rarely purple, regularly graduated or the wings a trifle longer than the banner, rarely all of equal length, the banner recurved through 45–90°, the keel-tip obtuse or sharply acute; *pedicels* not greatly thickened, tardily disjointing together with the fruit; *pod* pendulous, stipitate or subsessile, persistent on the receptacle, the body linear or narrowly oblong-elliptic in profile, straight or commonly incurved, ± trigonously compressed, bilocular or nearly so, the valves thinly or stiffly papery; *dehiscence* (unknown in some species) apical and sometimes downward through the ventral suture, usually after falling; *ovules* 7–37.—Spp. 13, xerophytes, of intermontane western United States, the Sierra Nevada, the Coast Ranges, 1 local in the Rocky Mountains of western Wyoming and central Idaho, 1 in Coahuila, 2 in the Sierra Madre Occidental (Sinaloa to northwestern Jalisco).

ASTRAGALUS sect. MISELLI (Rydb.), comb. nov., based on *Tium* sect. *Misella* Rydb. in N. Amer. Fl. 24: 388. 1929.—Sp. lectotypica: *T. misellum* (Wats.) Rydb. = *A. misellus* Wats.

With sect. *Miselli* I embark on the description of a new series of emmenoloboid sections, characterized by pendulous, mostly stipitate and nearly always bilocular pods, either dorsiventrally, trigonously, or rarely laterally compressed. They resemble the homaloboid sections in many respects, but differ in their free stipules and (with a few exceptions) in the presence of a septum in the fruit.

The thirteen members of the section fall into subsidiary groups, although these do not possess any substantial differential characters. The first six species, *A. Congdoni, A. umbraticus,* and *A. agnicidus* of cismontane California and Oregon, together with *A. Paysonii* of the forest belt in the Rocky Mountains and *A. ervoides* and *A. sinaloae* of oak-pine woodland in western Mexico, are set off from the remainder by their thin-textured, often visibly penninerved leaflets, white flowers, and short stipes. Although essentially xerophytes, the majority require comparatively cool soils or shaded exposures. Severally and collectively they appear to be mature species of considerable age, noteworthy for great morphological discontinuities between them and for restricted or discontinuous areas of dispersal. They are probably primitive. The next species, *A. carminis,* is technically similar to the foregoing except that the flowers are pink; it is isolated in Coahuila and is adapted, like the Mexican species already mentioned, to the rhythm of summer rains, flowering from June onward into fall. The remaining six species are found in the sagebrush deserts and desert foothills of intermontane United States. They have ochroleucous or purplish (one bright purple) flowers, a more pronounced xerophytic appearance, and mostly longer stipes to the fruit. The four confined to the Columbia River drainage are closely interrelated and probably of recent origin. The very local *A. toquimanus* of central Nevada is distinguished by a modified flower, but is otherwise similar to *A. misellus* of the last group; whereas *A. straturensis* combines the short stipe of the first series with narrow, firm leaflets and vivid purple flowers.

The eight species of sect. *Miselli* known to Rydberg are scattered in his monograph among three genera. He referred *A. umbraticus* and *A. Congdoni* to *Hamosa,* on account of the supposedly sessile pod which is in reality elevated on a stipe concealed by the marcescent calyx. *Tium* received the species with longer stipes, which constituted the typical elements of his sect. *Misella,* while *A. straturensis* was transferred to *Atelophragma,* even though the usually complete septum is at variance with the generic character. In the last instance Rydberg was following Jones (1923) who had placed the rest of the *Miselli,* so far as known to him at the time, in sect. *Hamosi,* a group so large and heterogeneous as to lack even the superficial virtue of pragmatic convenience.

Key to the Species of Sect. Miselli

1. Stipe of the pod 2.5–14 mm. long; *pod* pubescent; Columbia Basin, interior Washington and Oregon to w.-centr. and s.-centr. Idaho, all of the sagebrush zone at low or middle elevations (2)
   2. Calyx 5–8.8 mm., banner 10–16.5 mm., keel 8.2–12 mm. long; *leaflets* 19–27 (3)
      3. Body of the pod ± 2–3 cm. long and 5–7 times longer than wide, with flat lateral and openly sulcate dorsal faces, the valves densely short-villosulous; *herbage* villosulous with curly hairs, the leaflets pubescent on both sides; lower Deschutes and John Day Rivers, Wasco and Sherman Counties, w. feebly into Morrow County, Oregon ..... 128. *A. Howelli*
      3. Body of the pod 3–4.5 cm. long and ± 10 times longer than wide, with convex lateral and narrowly sulcate dorsal faces, the valves strigulose; *herbage* strigulose with ascending or incumbent hairs, the leaflets glabrous above; Snake and lower Clearwater Valleys about the common boundary-point of Oregon, Washington and Idaho, w. in Oregon to Umatilla County ..... 129. *A. Arthuri*
   2. Calyx 2.9–4.8 mm., banner 5.3–10 mm., keel 4–6.4 mm. long; if the banner nearly 10 mm. long then leaflets only 11–21 (4)
      4. Leaflets (7) 11–21; *peduncles* (1.5) 2.5–7 (10) cm. long; *banner* 7–10 mm. long; *body* of the pod 12–25 mm. long; *seeds* 2.2–2.7 mm. long; n.-e. Oregon and adjacent Washington ..... 130. *A. misellus*
      4. Leaflets (13) 17–25 (27); *peduncles* 0.5–2.5 cm. long; *banner* 5.3–6.8 mm. long; *body* of the pod 6–12 mm. long; *seeds* 1.5–1.8 mm. long; local in the foothills of the Sawtooth Mountains in Blaine County, Idaho ..... 131. *A. oniciformis*

1. Stipe of the pod less than 2.5 mm. long or, if slightly longer, then the body glabrous; distribution otherwise (5)
   5. Pod glabrous, with relatively long stipe 3–4 mm. long; *petals* of nearly equal length (± 7.5 mm.), the sharply triangular keel-tip nearly equaling the banner; *pod* mottled, glaucescent; local in Nye County, Nevada ..... 132. *A. toquimanus*
   5. Pod either glabrous or pubescent but the stipe shorter; *petals* graduated or, if subequal, shorter and the keel-tip obtuse; *pod* not mottled if glabrous; distribution otherwise (6)
      6. Flowers relatively large, white, the calyx 5.2–9 mm., the banner 10–16.5 mm. long; cismontane California and Oregon, or w. Durango (7)
         7. Stems and herbage villous-villosulous or pilose, the longest hairs at least 0.9 mm. long; *ovary* and pod pubescent (8)
            8. Racemes open, becoming loosely secund and mostly 5–20 cm. long in fruit; *calyx-teeth* subulate or triangular-subulate, 1–2.5 (3) mm. long; *pod* densely strigulose-villosulous, the stipe 1–2.5 mm., the body (1.5) 2–3.5 cm. long; *ovules* 23–29; foothills of Sierra Nevada, California ..... 120. *A. Congdoni*
            8. Racemes dense, little elongating, the axis 2–4.5 cm. long in fruit; *calyx-teeth* linear or lance-acuminate, 3.3–5 mm. long; *pod* thinly villous-pilose, the stipe scarcely 0.5 mm. long, the body 1.1–1.5 cm. long; *ovules* 8–9; Coast Range of Humboldt County, California ..... 121. *A. agnicidus*
         7. Stems and herbage nearly glabrous or appearing so, the scattered hairs truly appressed and not over 0.6 mm. long; *ovary* and pod glabrous (9)
            9. Banner 10.5–16.5 mm., keel 7.7–10 mm. long; *pod* strongly compressed laterally, narrowly grooved dorsally; cismontane California and Oregon ..... 122. *A. umbraticus*
            9. Banner less than 10.5 mm., keel 5.6–7.6 mm. long; *pod* triquetrous, the openly grooved dorsal face little narrower than the lateral ones; Durango; large-flowered forms of ..... 124b. *A. ervoides* var. *Maysillesii*
      6. Flowers smaller, variable in color, the calyx mostly 3–5 mm. long, the banner 5.2–10 mm. long, but if the calyx over 5 mm. then the petals pink-purple (10)
         10. Ovary and pod glabrous; Mexican species with regularly graduated petals and keel over 6 mm. long (11)
            11. Petals pink-purple; Coahuila ..... 126. *A. carminis*
            11. Petals white; Sierra Madre Occidental, Durango to Jalisco ..... 124. *A. ervoides*
         10. Ovary and pod pubescent; if of Mexico then the petals subequal and only 5–5.5 mm. long (12)
            12. Leaflets 17–27; *vesture* of the herbage and stems loosely appressed or curly; *petals* ochroleucous, the banner veined with brownish-purple; local in s.-centr. Idaho ..... 131. *A. oniciformis*

12. Leaflets 7–19; *vesture* truly appressed, often scanty; *petals* either white or bright purple; distribution otherwise (13)
13. Petals bright purple (drying violet); s.-e. Nevada to s.-w. Utah and n.-w. Arizona ..... 127. *A. straturensis*
13. Petals white, sometimes drying ochroleucous; distribution otherwise (14)
14. Petal graduated, the banner ± 7–9 mm. long, distinctly surpassing the keel; in the timber belt, w. Wyoming and centr. Idaho ..... 123. *A. Paysonii*
14. Petals of about equal length, 5–5.5 mm. long; Sinaloa ..... 125. *A. sinaloae*

120. Astragalus Congdoni

Diffuse, usually rather coarse but sometimes quite slender, villous-villosulous nearly throughout with widely ascending, straight, incurved, or ± sinuous (and often some shorter, curly), white (and toward the inflorescence often partly fuscous) hairs up to 0.9–1.4 mm. long, the stems and herbage either equally greenish-cinereous, or the stems, and sometimes the young herbage, white-villous-tomentulose, the leaflets equally pubescent on both sides or more thinly so above; *stems* several or numerous, decumbent and ascending from the pluricipital root-crown or shortly forking caudex, (1) 1.5–7.5 dm. long, striate, green or purplish-tinged, nearly always branched or spurred at 1–3 (4) nodes preceding the first peduncle, simple only when short and slender, floriferous upward from near or below the middle; *stipules* thinly herbaceous, the lowest becoming papery, fragile and brownish in age, ovate-, triangular- or lance-acuminate or -caudate, 2–8 mm. long, ± semiamplexicaul, pubescent dorsally, ciliate, the blades commonly squarrose; *leaves* spreading-recurved, (3) 4–12 (14) cm. long, the lowest shortly petioled, the upper ones sessile or nearly so, with (11) 17–35 (37) oblong-elliptic, ovate, obovate, or (especially in some lower leaves) suborbicular, truncate, retuse, retuse and mucronulate, rarely subacute, flat or loosely folded leaflets 3–15 mm. long, dorsally carinate by the midvein, diminishing upward along the rachis; *peduncles* either stout or (all or some upper ones) quite slender, (5) 7–18 (20) cm. long, surpassing the leaf; *racemes* loosely or at length remotely (8) 12–30 (35)-flowered, the flowers early spreading, ultimately declined, the axis elongating, (3.5) 5–20 cm. long in fruit; *bracts* submembranous, triangular- or narrowly lance-acuminate, 1.2–3.4 mm. long; *pedicels* at first ascending, straight or nearly so, 0.3–1.5 (2) mm. long, in fruit thickened, recurved, 0.5–2.2 (3) mm. long; *bracteoles* 0–2, minute when present; *calyx* 5.3–7.5 (8) mm. long, villosulous with fuscous, black, or partly white hairs, the subsymmetric to strongly oblique disc. 0.9–1.5 mm. deep, the membranous, pallid or purplish, broadly or narrowly campanulate tube 3.8–5 (5.3) mm. long, 2.5–4.2 mm. in diameter, the subulate or triangular-subulate teeth 1.1–2.5 (3) mm. long; *petals* white or whitish, immaculate, drying ochroleucous; *banner* recurved through ± 45°, broadly or narrowly oblanceolate, elliptic-oblanceolate, or rhombic-elliptic, shallowly or deeply notched, 10.4–15.6 (16.6) mm. long, 4.8–7 mm. wide; *wings* (shorter or rarely a trifle longer) 9–15 (16.2) mm. long, the claws 3.6–6.7 (7) mm., the linear-oblong or oblanceolate, obtuse, truncate-erose, or obliquely emarginate, slightly incurved blades 6.4–10 (10.4) mm. long, 2–3.4 (3.8) mm. wide; *keel* 7.4–12.7 mm. long, the claws 3.5–6.8 mm., the half-obovate blades 4.5–6.8 mm. long, 2.4–3.6 mm. wide, incurved through 90–95° to the bluntly deltoid apex; *anthers* (0.45) 0.5–0.75 mm. long; *pod* declined, the straight, glabrous or puberulent stipe 1–2.5 mm. long, concealed by the marcescent calyx, the body linear in outline, nearly straight to falcately incurved through ± ⅓-circle, (1.5) 2–3.5 cm. long, 2.3–3.2 mm. in diameter, abruptly cuneate at base, contracted distally into a short, triangular, cuspidate, unilocular beak, otherwise compressed-triquetrous, with low-convex lateral and slightly narrower, deeply but narrowly grooved dorsal

faces, carinate ventrally by the prominent suture, the lateral angles obtuse, the thinly fleshy, green or purple-tinged valves becoming stiffly papery, stramineous, finely cross-reticulate, densely to quite thinly strigulose-villosulous with subappressed, ascending and nearly straight, or looser and sinuous hairs, the complete or nearly complete septum 1–2 mm. wide; *ovules* (17) 23–29; *seeds* purplish- or chestnut-brown, or greenish, often purple-speckled, pitted, wrinkled, or both, scarcely lustrous, 2.2–3 mm. long.—Collections: 13 (ii); representative: *L. S. Rose 47,050* (CAS, SMU); *Barneby & Howell 11,417* (CAS, NY, POM, RSA), *11,466* (CAS, NY, POM, RSA, WS); *Eastwood & Howell 8743* (CAS); *Hoover* 4087 (NY).

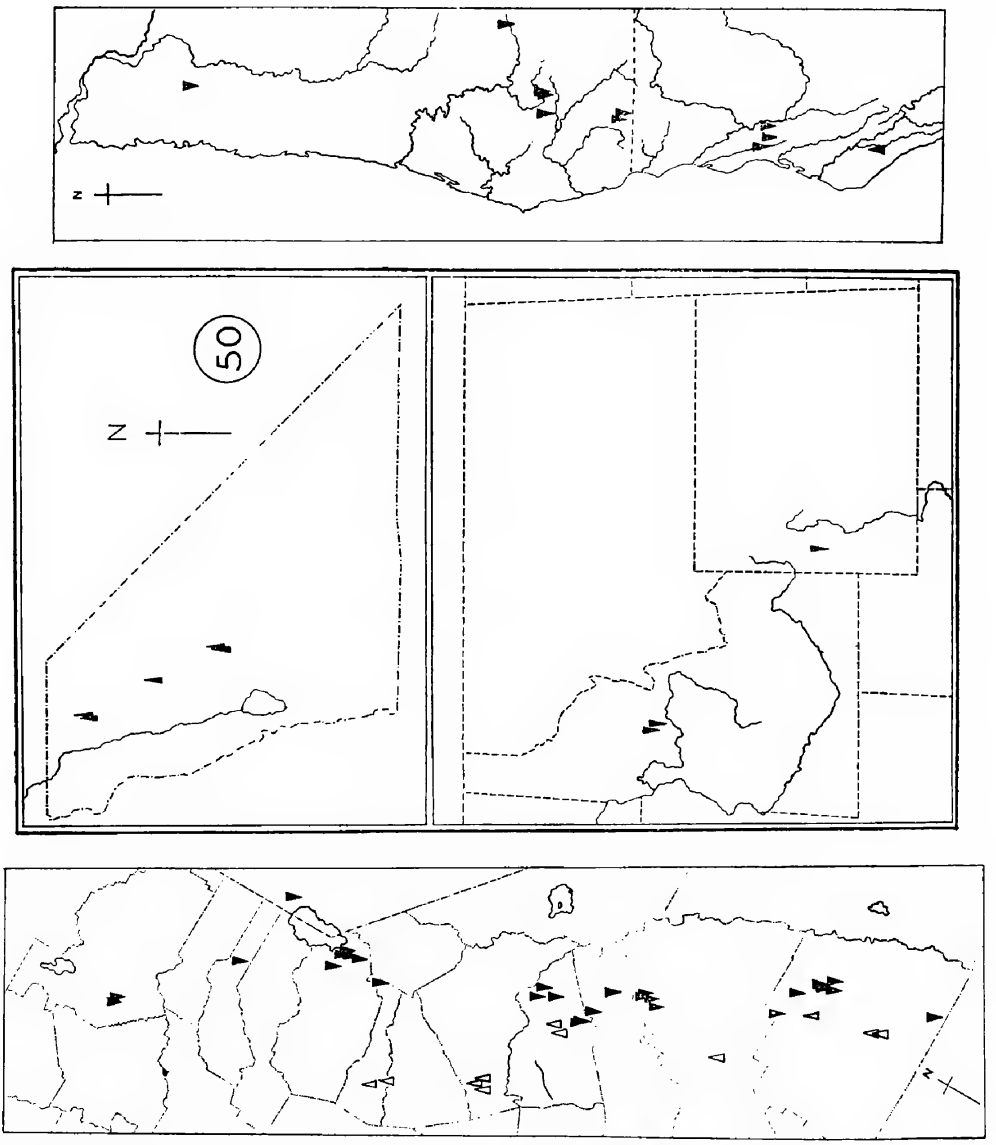
Open brushy banks, canyon sides, and road cuts, commonly on and perhaps confined to metamorphic, sometimes partly serpentinized bedrock, 550–2000 feet, uncommon, scattered within and slightly below the digger pine belt in the Sierra Nevada foothills from the Mokelumne south to the Tule River, Amador to Tulare County, California.—Map No. 50.—March to May (June).

ASTRAGALUS CONGDONI (Joseph Whipple Congdon, 1834–1910, attorney and plant collector, especially active botanically in Mariposa County and the North Coast Ranges) Wats. in Proc. Amer. Acad. 20: 360. 1885.—"At Hite's Cove on the Merced River, Mariposa County, California, collected by J. W. Congdon, June, 1883."—Holotypus, GH! isotypus, NY!—*Hamosa Congdoni* (Wats.) Rydb. in Bull. Torr. Club 54: 20. 1927.

In contrast to the rich development of the genus elsewhere in California, the astragaline flora of the Sierra's west slope is unexpectedly poor. In fact the Congdon milk-vetch is the only perennial astragalus known from the segment of Low Foothills (as defined by Jepson, 1925, p. 13) that extends from the Yuba River south to the Kern-Tulare County line. The species, far from common, consists of six or seven main populations concentrated into small areas in the valleys of the Mokelumne, Stanislaus, Tuolumne, Merced (both North and South Forks, immediately below Yosemite), Kings and Tule Rivers. The plants of *A. Congdoni* that J. T. Howell and I saw in the type-locality at Hite's Cove grew on a recently burned-over slope; at Piedra on Kings River, we saw an especially vigorous form only on road-cuttings and on debris under cliffs. Possibly the species requires, or at least prefers, a disturbed or unstable habitat. In both these stations the Congdon milk-vetch is associated with outcrops of metamorphic bedrock, and this may prove to be the factor determining its discontinuous dispersal. Isolation of the colonies may have favored different modes of variation from one valley to the next. The species is very variable in stature, density of vesture, size of flower, and length of pod, but its essential structural features are uniform. The nearest relatives of *A. Congdoni* are *A. agnicidus* and *A. umbraticus* of the outer Coast Ranges; the relationship, however, is not really close. The copious, loose pubescence, the open, secund racemes of white flowers, and the long, narrow, hanging pods are distinctive.

121. ASTRAGALUS AGNICIDUS

Tall, robust, leafy, perennial but sometimes flowering the first season, the stems becoming indurated at base but hardly caudiciform, nearly glabrous proximally, becoming thinly villous upward like the herbage with fine, weak, horizontal or widely ascending, straight or subsinuous hairs up to 1–1.6 mm. long, the herbage green but the leaflets bicolored, pallid and pubescent along the midrib beneath, deeper green and glabrous above, long-ciliate, the inflorescence black-hairy; *stems* several, erect and virgately ascending, (3) 4–9 dm. long, spurred or branched at 1—several nodes preceding the first peduncle, often purplish at base, becoming stramineous, striate, and hollow upward, floriferous from ± 8–12 nodes above the middle; *stipules* submembranous, pallid, 4–15 mm. long, the lowest ovate or triangular, decurrent around nearly the whole stem's circumference, the rest lance-acuminate or -caudate, semiamplexicaul-decurrent, the deflexed blades glabrous dorsally or nearly so, ciliate and often beset with a few minute processes; *leaves* (3.5) 5–12 (16) cm. long, the lowest slender-petioled, the rest subsessile, with (13) 19–27 ovate, lance-oblong, or (especially in some lower



Map No. 50. Left, Sierra Nevada, California. Range of ▼ *A. Bolanderi*; and of ⌂ *A. Congdoni*. Top center, Inyo County, California. Range of *A. inyoensis*. Bottom center, Idaho and Wyoming. Range of *A. Paysonii*. Right, coast of Oregon and northern California. Range of ▼ *A. umbraticus;* and of ▲ *A. agnicidus*.

leaves) oblong-obovate, truncate and mucronulate, retuse, obtuse or rarely subacute, flat, thin-textured, faintly penninerved leaflets (3) 5–22 mm. long, the midrib prominent beneath; *peduncles* erect, 5–13 cm. long, about equaling the leaf; *racemes* densely (10) 15–40-flowered, the flowers early spreading and then declined, the axis little elongating, (1) 2–4.5 cm. long in fruits; *bracts* submembranous becoming hyaline, deflexed in age, narrowly lanceolate or linear-caudate, 2–6 mm. long; *pedicels* at full anthesis arched out- and downward, 0.6–0.8 mm. long, in fruit thickened, 1.2–1.8 mm. long; *bracteoles* 0–2, minute when present; *calyx* 6.6–9 mm. long, thinly villous-villosulous with black hairs, the subsymmetric disc 0.7–1.2 mm. deep, the membranous, campanulate, pallid or purplish tube

3.2–4.3 mm. long, 2.4–3 mm. in diameter, the linear or narrowly lance-acuminate or -caudate, herbaceous teeth 3.3–4.9 mm. long; *petals* white, immaculate; *banner* gently recurved through 45°, broadly oblanceolate, rhombic, or rhombic-obovate, notched, 9.1–11 mm. long, 4.5–5.3 mm. wide; *wings* 8.3–9.2 mm. long, the claws 3.3–4.2 mm., the oblong-oblanceolate or obliquely triangular-obovate, obtuse or (when broad) obliquely emarginate, nearly straight blades 5.4–6.5 mm. long, 1.5–2.6 mm. wide; *keel* 7–7.4 mm. long, the claws 3.2–4.1 mm., the half-obovate blades 3.9–4.2 mm. long, 2–2.4 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid apex; *anthers* 0.5–0.6 mm. long; *pod* declined or deflexed, subsessile, the stipe 0.3–0.4 mm. long, the body obliquely lanceolate in profile, 11–15 mm. long, 3–3.4 mm. in diameter, slightly incurved, rounded at base, contracted at apex into a narrowly triangular-subulate, cuspidate, slightly declined beak 2–3.5 mm. long, otherwise compressed-triquetrous, keeled ventrally by the prominent, gently concave-arcuate suture, the almost plane lateral faces nearly twice as broad as the narrowly grooved dorsal one, the thin, green valves becoming papery, stramineous or ultimately brownish, finely cross-reticulate, villosulous with loosely ascending hairs, the septum complete, 1.5–2.2 mm. wide; *ovules* 8–9; *seeds* (not quite ripe) brown, smooth, 1.7–2.1 mm. long.—Collections: 3 (i).

Openings on brushy ridges in partially timbered forest land, about 2500 feet, apparently very local, known only from the type-station in the outer North Coast Range, near Miranda, Humboldt County, California.—Map No. 50.—Late May to August.

ASTRAGALUS AGNICIDUS (lamb-killer) Barneby in Madroño 14: 39. 1957.—"CALIFORNIA. "Local on Tosten & Peirce Ranch, near Bear Buttes, 4 miles s. of Miranda, Humboldt County, alt. about 2500 ft., June 7, 1931, Henry Tosten ex herb. J. P. Tracy . . . "—Holotypus (2 sheets), UC!

The imperfectly known history of the lambkill milk-vetch, *A. agnicidus,* was told in the original publication; nothing new can be added. A shadow of doubt as to its status as native to California still hangs over the species on account of its former weedy abundance in recently logged-over woodland and of a tradition that it was introduced, supposedly from the Great Valley. Attempts to identify it with some exotic astragalus have been unavailing. It has been mentioned that *A. Congdoni,* a species apparently related to *A. agnicidus,* shows a preference for disturbed habitats, and it seems possible that the present species is similarly adapted. It might be supposed that, like some of the annual Californian fireweeds, it depended in the past on natural catastrophes, similar in effect to changes wrought by man, to provide open ground for periodic seasons of abundance. This remains in the realm of hypothesis until more data (and especially new stations) can be secured.

The lambkill milk-vetch resembles *A. Congdoni* and *A. umbraticus* in the relatively coarse, leafy habit of growth, in the white flowers, and in form of the pod; but it differs from both in many technical characters of which the thin, villous pubescence of weak and long, spreading hairs and the dense racemes are especially notable. The more copiously pubescent *A. Congdoni* of the Sierra Nevada has much longer, pluriovulate pods, while *A. umbraticus,* also of the Coast Ranges but not ranging quite so far south, has nearly glabrous foliage and fully glabrous pods, longer and more strongly incurved.

It was Henry Tosten who noticed the poisonous nature of *A. agnicidus,* identifying it as the cause of severe losses among his lambs, and thus brought it to the notice of Mr. Tracy. The toxic principle, presumably a locoine, is still to be isolated.

122. ASTRAGALUS UMBRATICUS

Rather tall but often quite slender, appearing nearly glabrous but bearing a few scattered, straight, appressed or narrowly ascending hairs up to 0.3–0.7 mm. long on the stems distally and on the margins and midribs of the deep or pale green leaflets, the inflorescence thinly black-strigulose; *stems* several, diffuse or ascending from the knotty root-crown or shortly forking caudex, (2) 2.5–5 dm. long, pale green becoming stramineous, striate, simple or nearly so; *stipules* 3.5–9.5 mm. long,

the lowest early becoming papery and brownish, embracing ¾ to nearly the whole stem's circumference, the upper ones submembranous, longer and narrower, triangular or lance-acuminate, thinly ciliate; *leaves* 4–12 cm. long, the uppermost shortly petioled or subsessile, with (11) 15–23 broadly oblong, ovate, or obovate, or (in some lower leaves) suborbicular, retuse or abruptly short-acuminate, flat, thin-textured leaflets (4) 6–16 (20) mm. long; *peduncles* erect or incurved-ascending, 5–12 cm. long, ± equaling the leaf; *racemes* loosely but shortly 10–25-flowered, the flowers early horizontal, at length declined, the axis little elongating, (1.5) 2–5 cm. long in fruit; *bracts* membranous, narrowly lanceolate, (1.7) 2–4 mm. long; *pedicels* at anthesis ascending or a little arched outward, 0.6–1.2 mm. long, in fruit ascending or more strongly arched, a little thickened, scarcely longer; *bracteoles* 0; *calyx* 5.2–7 mm. long, strigulose or pilosulous with dark hairs, the somewhat oblique disc 0.7–1.2 mm. deep, the campanulate tube 3.1–4 mm. long, 2.1–3.2 mm. in diameter, the subulate or lance-subulate teeth 2.1–3.2 mm. long; *petals* greenish-white, often drying cream-color, immaculate; *banner* recurved through 40–60°, narrowly to broadly ovate-cuneate or rhombic-elliptic, 10–14 mm. long, 5–8 mm. wide; *wings* 8.4–11 mm. long, the claws 3.5–4.8 mm., the claws 3.5–4.8 mm., the oblong-oblanceolate, obtuse, obliquely truncate and erose, or shallowly emarginate, slightly incurved blades 6–7.6 mm. long, 2–2.9 mm. wide; *keel* 7.7–10 mm. long, the claws 3.7–5.6 mm., the half-obovate or lunately half-elliptic blades 3.8–5 mm. long, 2.1–3 mm. wide, incurved through 95–100° to the bluntly deltoid apex; *anthers* (0.35) 0.4—0.55 mm. long; *pod* spreading or declined, stipitate but the obscure stipe only 0.8–1.9 mm. long, concealed by the calyx, the body lunately or falcately linear-lanceolate or linear in profile, evenly incurved through ¼–½-circle, 1.4–2.4 cm. long, 2.6–3.6 mm. in diameter, cuneate at base, acuminate and cuspidate at apex, laterally compressed-triquetrous, with low-convex lateral and narrower, narrowly but deeply grooved dorsal faces, keeled ventrally by the salient suture, the firmly papery, glabrous valves at first green becoming stramineous and ultimately blackish, delicately cross-reticulate, inflexed as a complete septum 1.5–2.3 mm. wide; *ovules* 10–15; *seeds* compressed-quadrangular, brown, smooth but dull, 2.2–2.6 mm. long.—Collections: 15 (o); representative: *Jones* (from Glendale) *in 1902* (CAS, NY, POM); *C. L. Hitchcock 19,381* (UC, WS); *W. H. Baker 858* (ID, RSA); *Tracy 4575* (UC); *Peck 8209* (WILLU); *Quick 57–24* (CAS).

Dry open oak and pine woodlands, ± 600–4000 feet, uncommon, outer Coast Ranges of Oregon and northern California, apparently most frequent in the valleys of the Coquille, Rogue, and Illinois Rivers in southern Douglas and Josephine Counties, extending north, apparently greatly isolated, to Yamhill County, and south in widely scattered stations to the lower Trinity River and Redwood Creek in Humboldt County, California; not known from the Umpqua drainage in the Coast Ranges, but extending east on the headwaters of that stream into the Cascade foothills (20 miles northeast of Tiller, Douglas County, *Quick 57–24*, CAS).—Map No. 50.—May to July.

ASTRAGALUS UMBRATICUS (of shady habitat) Sheld. in Minn. Bot. Stud. 1: 23. 1894, a substitute for *A. sylvaticus* (of woodland) Wats. in Proc. Amer. Acad. 23: 262. 1888 (non Willd., 1801).—"Near Glendale, in southern Oregon, 'in open gravelly ground' (L. F. Henderson) or 'in dense forests' (Thomas Howell, June, 1887)—who suggests the name."—Lectotypus, *T. Howell 674*, collected June 30, 1887, GH! isotypi (some not or differently numbered), ORE, WS, WTU! paratypi, *Henderson 1342*, GH, ND, ORE ("open ground along the railroad"). —*Hamosa umbratica* (Wats.) Rydb. in Bull. Torr. Club 54: 19. 1927.

I have no field experience with the sylvan milk-vetch, *A. umbraticus*, and other collectors have left almost no record of its ecology. There is presumptive evidence that it occurs, at least sometimes, on metamorphic and serpentine formations. Its center of dispersal lies in the

Klamath Highland, a region rich in endemic relics. The homogeneous nature of the material studied, considered in the light of the wide morphological gap between the species and its nearest relatives, is suggestive of age and a long period of isolation. The broad, flat, green and nearly glabrous leaflets, the small, white flowers, and the glabrous, compressed-triquetrous, strongly but evenly incurved pods are distinctive.

123. Astragalus Paysonii

Rather slender perennial, with a taproot and shortly forking caudex, appearing glabrous but the stems, lower surface of the leaflets, and the ovary and pod thinly strigulose with fine, straight, appressed or narrowly ascending hairs up to 0.4–0.6 mm. long, the thin-textured leaflets bicolored, bright green above, pallid and subglaucescent beneath; *stems* several or numerous, sometimes forming "large clumps," decumbent and ascending, 2–4.5 dm. long, simple or spurred at 1–2 nodes preceding the first peduncle; *stipules* submembraneous becoming papery, 2–5 mm. long, the lowest ovate-triangular, decurrent around ± ½ the stem's circumference, the upper ones lanceolate or lance-acuminate, more shortly cauline, commonly reflexed; *leaves* 4–9.5 cm. long, all petioled but the upper ones very shortly so or subsessile, with 7–15 (17) ovate, ovate-oblong, or obovate-cuneate, mostly retuse, flat leaflets 5–20 mm. long; *peduncles* slender, incurved-ascending, 3–9 cm. long; *racemes* at first rather closely 5–20-flowered, the flowers ascending and early declined, the axis somewhat elongating, 1–4.5 cm. long in fruit; *bracts* membranous, ovate or lanceolate, 0.8–2 mm. long; *pedicels* at anthesis 0.5–0.7 mm. long, in fruit arched outward, somewhat thickened, 1–1.2 mm. long; *bracteoles* 0; *calyx* 3.2–4.6 mm. long, densely strigulose with black or black and white hairs, the subsymmetric disc 0.6–0.8 mm. deep, the campanulate tube 2–2.9 mm. long, 2–2.5 mm. in diameter, the triangular-subulate teeth 1–1.7 mm. long, the whole becoming papery, marcescent; *petals* whitish, apparently sometimes faintly lilac-tinged; *banner* recurved through 45°, ovate-cuneate, retuse, 7–9 mm. long, 5.2–5.6 mm. wide; *wings* 6.4–7.8 mm. long, the claws 2–2.6 mm., the oblong-obovate, obtuse, moderately incurved blades 4.9–5.8 mm. long, 2–2.5 mm. wide; *keel* 4.8–5.5 mm. long, the claws 2–2.5 mm., the half-obovate blades 3.1–3.3 mm. long, ± 2 mm. wide, incurved through 115–130° to the bluntly deltoid, obscurely porrect apex; *anthers* 0.3–0.45 mm. long; *pod* pendulous (or widely spreading from horizontal peduncles), stipitate, the stipe 1–1.5 mm. long, concealed by the calyx, the lunately linear-ellipsoid body 1–1.7 cm. long, 2.5–3.5 mm. in diameter, cuneately contracted at both ends, at apex into a straight, subulate cusp 1–1.5 mm. long, triquetrously compressed, with low-convex lateral and deeply but narrowly sulcate dorsal faces, carinate ventrally by the thick, straight or gently concave suture, the thin, greenish-stramineous, thinly strigulose valves becoming papery, stramineous or brownish, cross-reticulate, inflexed as a complete septum 1.3–2 mm. wide; *dehiscence* apical, tardy; *ovules* 8–10; *seeds* (little known) brown, smooth, 1.9–2.1 mm. long.—Collections: 3 (o); representative: *Christ 18,183* (ID, RSA); *R. J. Davis s. n.* (RSA).

Open places in the timber belt, sometimes in burned-over forest, on decomposed granites, rare and local, known only from the Green-Snake River watershed in Sublette County, Wyoming (west of Merna), and from the Clearwater Mountains (4 miles east of Red River Ranger Station; Indian Hill), Idaho County, northcentral Idaho.—Map No. 50.—July to October.

Astragalus Paysonii (Rydb.) Barneby in Leafl. West. Bot. 4: 60. 1944, based on *Hamosa Paysonii* (Edwin Blake Payson, 1893–1927, professor of botany at RM) Rydb. in Bull. Torr. Club 54: 22. 1927.—"Type collected at Horse Creek, seven miles west of Merna, Sublette County, Wyoming, *Payson & Payson 2748* . . . "—Holotypus, collected July 18, 1922, NY! isotypi, GH, MO, US!

Despite the great distance between the two areas from which the Payson milk-vetch is known at present, the material is essentially uniform and certainly conspecific. Intermediate stations must be expected to appear, as the great mountain wilderness of western Wyoming is more thoroughly explored botanically. No close floristic relationship is known to exist between the Clearwater Mountains and those of the Tetons and adjoining ranges in Wyoming, but there are several interesting links between the floras of the Oregon Coast Ranges and the Clearwaters. In the sectional key *A. Paysonii* has been contrasted with a small-flowered Mexican species, but its nearest relative is probably the cismontane *A. umbraticus* from which it is distinguished by its fewer leaflets, tiny flowers, and few-ovulate, puberulent pod. Little is known of the ecology of the Payson milk-vetch. It was originally discovered in burned-over spruce and fir forest, a circumstance which recalls the preference of some cismontane *Miselli*, notably *A. Congdoni* and *A. agnicidus*, for a disturbed habitat. In Idaho it was found by R. J. Davis (personal comm.) in openings of Douglas fir forest, in moderately moist soil at about 7200 feet, a habitat similar to that favored by *A. umbraticus*, even though at much greater altitude. Everything points to a common origin with the white-flowered cismontane species of the section.

124. Astragalus ervoides

Diffuse, caulescent perennial, with a taproot and pluricipital root-crown or shortly forking caudex at soil-level, thinly strigulose with fine, straight, appressed hairs up to 0.15–0.4 mm. long, or essentially glabrous below the thinly black- or fuscous-strigulose inflorescence, the herbage full, deep green, the leaflets glabrous above; *stems* several, decumbent or incurved-ascending, or prostrate, (1) 1.5–6.5 dm. long, simple or spurred at 1–5 nodes preceding the first peduncle, naked and often purplish at base, floriferous upward from above the middle; *stipules* 1–5 mm. long, the lowest small, ovate or deltoid, submembranous becoming papery, brownish, fragile, the median and upper ones longer, triangular-acuminate or lanceolate, herbaceous, semiamplexicaul, mostly deflexed; *leaves* 2–8 cm. long, all shortly petioled or all but the lowest subsessile, with (11) 13–25 oval to narrowly oblong-elliptic or -obovate, more rarely linear- or lance-elliptic, retuse, retuse and mucronulate, or obtuse, flat or loosely folded leaflets 3–13 mm. long; *peduncles* incurved-ascending or erect, 3–9 cm. long, either shorter or longer than the leaf; *racemes* (5) 7–40-flowered, either loose or quite dense at early anthesis, the flowers quickly declined, the axis little elongating, 1.5–4 cm. long in fruit; *bracts* membranous, ovate-triangular to narrowly lanceolate, lance-acuminate, or -caudate, 0.7–4 mm. long; *pedicels* at first ascending, early arched outward, at anthesis 0.2–1 mm., in fruit thickened, 0.6–1.8 mm. long, probably persistent or only tardily disjointing with the fruit; *bracteoles* 0–2; *calyx* 3.4–7.2 mm. long, thinly black- or fuscous-strigulose, the subsymmetric or oblique disc 0.5–0.8 mm. deep, the membranous, pallid or purplish, campanulate tube 2.1–3.8 mm. long, 2–2.7 (2.9) mm. in diameter, the teeth variable in shape and length, less than half as long to nearly twice as long as the tube, the whole becoming papery, marcescent unruptured; *petals* white or pale creamy ("pale yellow"), the banner faintly tinged or veined with lilac, the keel tip sometimes purplish; *banner* recurved through ± 40–45°, broadly oblanceolate, spatulate, or broadly rhombic-obovate beyond the cuneate claw, openly and shallowly notched, 6.3–10.2 mm. long, 3.4–6 mm. wide; *wings* nearly as long or a trifle longer, the blades narrowly oblong, lanceolate, or elliptic-oblanceolate, obtuse, truncate, or emarginate, slightly and equally incurved; *keel* 5.6–7.6 mm. long, the blades half-obovate or broadly half-elliptic, abruptly incurved to the sharply or bluntly deltoid apex; *anthers* (0.3) 0.35–0.55 mm. long; *pod* declined or deflexed, shortly stipitate or subsessile, persistent on the receptacle, the stipe 0.4–1.5 mm. long, the body linear- or narrowly lance-ellipsoid, gently incurved, 11–18 mm. long, 2.2–4 mm. in diameter, cuneately contracted at base into the stipe, more gradually attenuate distally into an erect or obscurely declined, lanceolate or lance-triangular, laterally compressed beak about 1–2.5 mm. long, otherwise triquetrous, carinate ventrally by the salient

suture, openly but deeply grooved dorsally, the lateral faces nearly flat, the lateral angles narrow but obtuse, the thin, green or purplish, glabrous valves becoming papery, greenish-stramineous or finally brownish, delicately cross-reticulate, inflexed as a complete septum 1–2.4 mm. wide; *dehiscence* (seldom observed) apical, the beak slightly gaping; *ovules* (8) 10–21; *seeds* (imperfectly known) yellowish-buff, smooth but scarcely lustrous, 1.8–2.2 mm. long.

The concept of *A. ervoides* H. & A. has always been somewhat spectral to American students of *Astragalus*. Described from specimens collected "between San Blas and Tepic" by Dr. Sinclair on Beechey's Voyage, it has been the subject of much nomenclatural comment; but until recently no material matching Hooker's description or the phototypus preserved in the herbaria at NY and POM has been available for direct study. The descriptions given by Jones (1923, p. 274) and Rydberg (1929, sub *Hamosa Hookeriana*) were compiled. Obviously no just estimate of the species or its affinities has been possible. It may be of interest, nevertheless, if only as a cautionary tale, to look back at Jones's attempt at an evaluation.

During the spring of 1927 Marcus Jones botanized rather extensively in the hill-country back of Tepic in Nayarit, where he was deliberately in search of *A. ervoides*. The species flowers after the summer rains, and probably occurs at elevations not reached by Jones, so it is not surprising that he was unsuccessful. We may legitimately wonder, however, at his assumption that a plant which had eluded his search in the recorded type-locality must in reality grow elsewhere. Noting that the climate and environment of Tepic had much in common with those of the mountainous Cape region of Baja California, he concluded that a species named by himself from there, and apparently endemic, *A. lagunensis* Jones, must in reality represent the long-lost *A. ervoides* (cf. in detail, Contrib. West. Bot. 15: 133–135. 1929). The identification of *A. ervoides* with *A. lagunensis* is especially difficult to understand in view of the discrepancies between the two in so many characters. The Cape species is a slender annual (possibly biennial) with ascending, purple flowers, elongate calyx-teeth, and nearly straight, ascending, strigulose pods. Hooker's plant was described as perennial, with early reflexed, ochroleucous flowers, short calyx-teeth, and deflexed, glabrous fruits.

Having most of these facts in mind, I received a few years ago (from Dr. Rogers McVaugh) with especially keen pleasure two beautifully prepared sheets of an astragalus collected in pine forest between seven and eight thousand feet in the coastal cordillera of western Jalisco. This closely matches in every detail, except the slightly broader leaflets, the phototypus of *A. ervoides* already mentioned. Subsequently a second gathering, from Cerro de San Juan, southwest of Tepic *(Pennell 19,981)*, turned up in a folder of undertermined astragali at NY, this resembling the typus even up to the linear leaflets; and a third has been found in a Hinton collection from coastal Michoacán. The description of var. *ervoides* has been prepared from the holotypus and these three collections. It should be noted that Hooker & Arnott's original account is misleading in one particular: having described the leaflets as "about half an inch long," they continued, "Flowers of the same length . . . " Actually the flowers cannot have measured more than 7 mm. when fresh. It may be worth recording that the holotypus is labeled "Acapulco, *Beechey*," although a fragment in the herbarium of Bentham (K, photo at POM) bears the locality-data as published, "San Blas to Tepic." Bentham himself subsequently (in Bot. Voy. Sulphur, p. 81) shortened the locality to "Tepic." Pennell's rediscovery of *A. ervoides* near Tepic confirms the accuracy of the first account.

Although typical *A. ervoides* is known from so few collections, ample material is available of a related form which seems to be common in the pine forests of the Sierra Madre in western Durango. The Durango plants differ among themselves very considerably in stature, number of flowers to the raceme, and size of the individual flower; they seem to differ collectively from *A. ervoides* only in the shorter stems, shorter peduncles, longer (ordinarily much longer) calyx-teeth, and more numerous ovules. The pod is known from inadequate samples, but seems not to differ substantially either in size or form from that of the typical phase. It may be separated varietally as follows :

Key to the Varieties of A. ervoides

1. Stems 3.5–6.5 dm. long; *peduncles* (4) 5–9 cm. long, longer than the leaf; *calyx-teeth* deltoid or broadly triangular, 0.7–1.1 mm. long; *ovules* 10–12; Nayarit to extreme w. Michoacán ..... 124a. var. *ervoides*

1. Stems (1) 1.5–3 dm. long; *peduncles* 3–7 cm. long, shorter than the leaf; *calyx-teeth* subulate to narrowly lance-attenuate, 1.2–4.2 mm. long; *ovules* (12) 14–20 (21); Durango ..... 124b. var. *Maysillesii*

124a. Astragalus ervoides var. ervoides

Minutely strigulose, the hairs up to 0.15–0.25 mm. long; *stipules* 1–2.5 mm. long; *leaflets* (11) 13–21, oval, narrowly oblong-elliptic, or linear; *racemes* (5) 7–14-flowered; *calyx* 3.4–4.6 mm., the tube 2.6–3.8 mm., the teeth 0.7–1.1 mm. long; *banner* 6.6–7.4 mm. long; *wings* 6.8–7.3 mm. long; *keel* 5.8–6.7 mm. long, the claws 2.9–3.4 mm., the blades 3.1–3.7 mm. long, 2.1–2.3 mm. wide.—Collections: 3 (o); representative: *McVaugh 14,145* (MICH, P, RSA); *Pennell 19,981* (NY); *Hinton 12,727* (NY).

Mountain slopes, in pine forest, 5200–8000 feet, sometimes in thin soil overlying pumice, locally plentiful, known only from the coastal cordillera of southern Nayarit ("San Blas to Tepic"; Cerro de San Juan, southwest of Tepic), northwestern Jalisco (± 20° N., 104° 30′ W.), and extreme western Michoacán (Coalcomán District).—Map No. 51.—August to December.

Astragalus ervoides (resembling a lentil) H. & A., Bot. Beechey Voy. 417. 1840.—"Hab. San Blas to Tepic."—Holotypus, K! phototypi, NY, POM!—*A. Hookerianus* D. Dietr., Syn. Pl. 4: 1076. 1847, a superfluous substitute, the supposed obstacle, *A. ervoides* Turcz., Cat. Baical. No. 352 in Bull. Soc. Nat. Mosc. 1838, p. 90, being a nom. nud. validated only by Ledebour, Fl. Ross. 1: 617. 1842. *Tragacantha ervoides* (H. & A.) O. Kze., Rev. Gen. 944. 1891 (*"ervodes"*). *Astragalus apertus* (open, the allusion obscure) Sheld. in Minn. Bot. Stud. 1: 166. 1894, a substitute for *A. Hookerianus* D. Dietr., non *A. Hookerianus* (T. & G.) Gray, 1866, itself a later homonym. *A. tepicus* (of Tepic) Sheld., op. cit. 172. 1894, a duplication of the preceding. *Hamosa Hookeriana* (D. Dietr.) Rydb. in N. Amer. Fl. 24: 435. 1929.

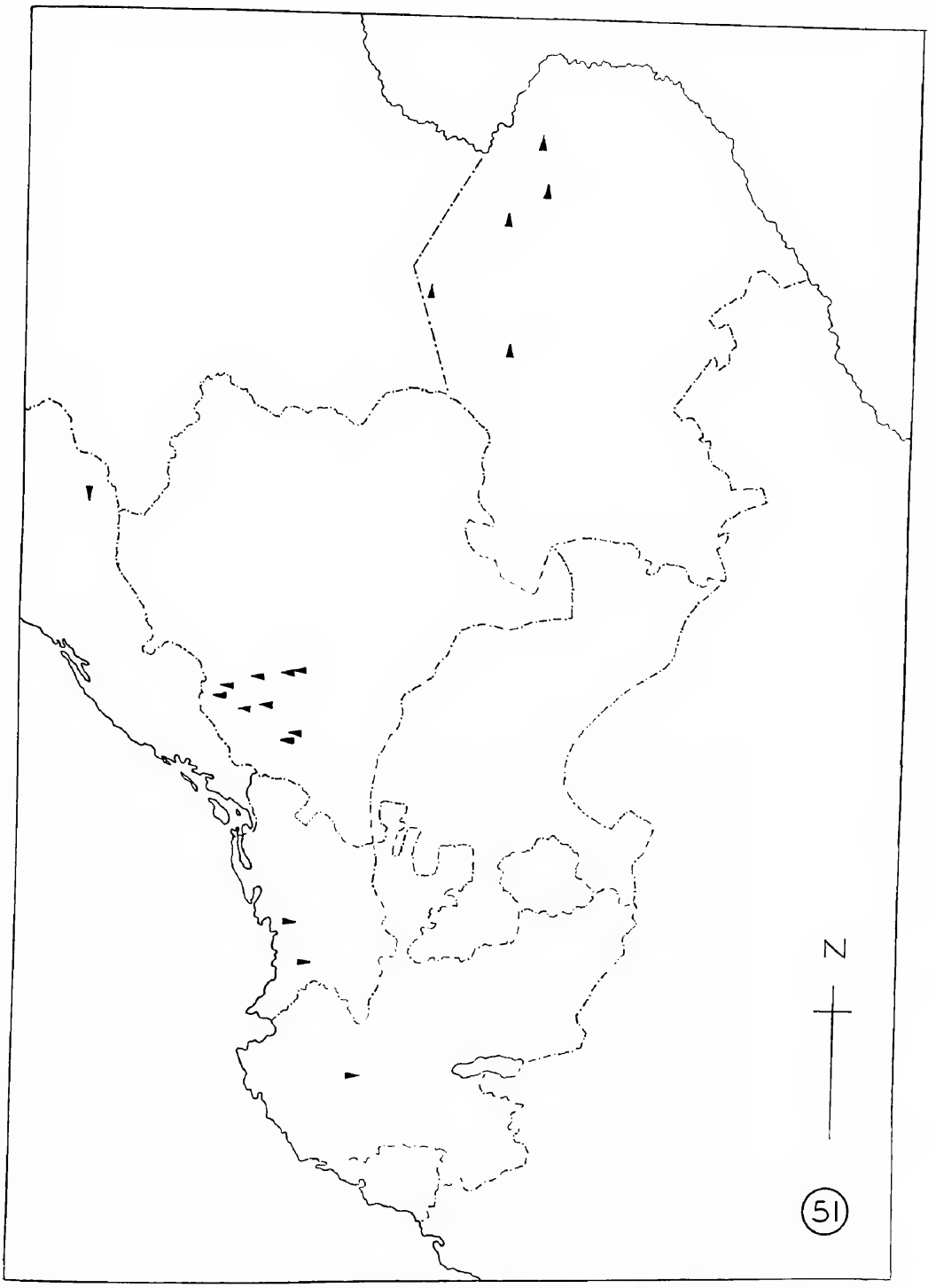
The Tepic milk-vetch, a slender, diffuse astragalus with small, greenish-white or yellowish flowers and pendulous, shortly but manifestly stipitate, narrowly lance-ellipsoid, triquetrous pod, is so greatly isolated from its apparent relatives, other than *A. sinaloae* described below, that no emphasis need be laid on its specific distinctness. In size and coloring of the flower *A. ervoides* resembles the rare *A. Paysonii* of Wyoming and Idaho, which differs in the pubescent pod and fewer leaflets of broader outline. From *A. sinaloae*, which also has a strigulose fruit, the present species is distinguished further by its slightly larger flowers with keel decidedly shorter, and not as long as the banner.

124b. Astragalus ervoides var. Maysillesii

Thinly strigulose with hairs up to 0.2–0.45 mm. long, or glabrous below the thinly black- or fuscous-strigulose inflorescence; *stipules* 1–5 mm. long; *leaflets* (11) 13–25, narrowly oblanceolate, oblong-elliptic, or -obovate, more rarely linear- or lance-elliptic; *racemes* usually 20–40-, more rarely only 7–19-flowered; *calyx* 3.6–7.2 mm. long, the tube 2.1–3.2 mm., the teeth 1.2–4 (4.2) mm. long; *petals* white or pale cream-color, the keel-tip often faintly purplish, the banner sometimes lilac-tinged or -veined; *banner* 6.3–10.2 mm. long; *wings* (0.5 mm. shorter to 0.7 mm. longer than the banner) (6.6) 7–9.9 mm. long, the claws 2.6–4 mm., the blades (4.5) 4.8–7.3 mm. long, 1.4–2.7 (3) mm. wide; *keel* 5.6–7.6 mm. long, the claws 2.8–3.7 mm., the blades 3.2–4.2 mm. long, 1.9–2.4 (2.7) mm. wide.—Collections: 19 (i); representative: *Maysilles 7425, 7876* (MICH, RSA), *7121, 8158* (MICH); *M. C. Johnston 2704* (RSA, TEX); *Waterfall 13,640, 13,641* (RSA); *Pennell 18,391* (NY); *Ripley & Barneby 13,490* (NY, RSA).

Open rocky fields, meadow grasslands in oak brush, glades in xeric pine forest, more rarely in humid pine or oak woods, sometimes on limestone, 6700–9000 feet, apparently common in the Sierra Madre Occidental west of Durango, especially about the villages of Otinapa, El Salto, Coyotes Hacienda, and Llano Grande.—Map No. 51.—July to November.

Astragalus ervoides var. Maysillesii (James H. Maysilles), var. nov., a var. *ervoideo* statura humiliori (caulibus saepissime 1–3 dm. tantum longis), pedunculis folio suffulcranti brevioribus, dentibus calycinis subulatis vel anguste lanceolatis elongatis (1.2–4.2 mm., nec



Map No. 51. Parts of northern and western Mexico. Range of ▲ *A. carminis*; of *A. ervoides*: ◗ var. *ervoides*; and ◖ var. *Maysillesii*; and of ▼ *A. sinaloae*.

0.7–1.1 mm. longis), ovulisque magis numerosis (saepissime 14–20, nec 10–12) absimilis.—DURANGO: from El Salto south along the lumber road toward Pueblo Nuevo (about 60 air-line miles southwest of Durango); 26–29 August, 1952, *J. H. Maysilles 7824*.—Holotypus, MICH!

The Maysilles milk-vetch occurs in two superficially disparate forms which I attempted, in the first instance, to separate in the following terms:

a. Racemes 20–40-flowered; *flowers* relatively large, the *calyx* 4.6–7.2 mm., its *teeth* 2.2–4.2 mm., the *banner* 8.6–10.2 mm., the *keel* 6.2–7.6 mm. long.

a. Racemes 7–19-flowered; *flowers* smaller, the *calyx* 3.6–4.5 mm., its *teeth* 1.2–1.7 mm., the *banner* 6.3–7.7 mm., the *keel* 5.6–6.2 mm. long.

The more slender, rarer, small-flowered phase (*Maysilles 7015, 7313, 8128,* all MICH) closely approaches var. *ervoides* in its comparatively few flowers of similar size, but differs in its short stems and consistently more numerous ovules. It serves as a connecting link between var. *ervoides* and the commoner, more robust state of var. *Maysillesii,* which might otherwise deserve specific status. That the plants of the two types from western Durango all represent one variable entity seems proven by comparison of *Maysilles 8128* with the same collector's *Nos. 7121* and *7129,* all taken, although in different seasons, from the same locality five miles north of Coyotes. The possible existence of two related forms living in close proximity, but separated by some unknown edaphic factor, seems unlikely but should perhaps be borne in mind.

125. Astragalus sinaloae

Slender, surely perennial but the root and caudex not seen, minutely strigulose with appressed hairs up to 0.15–0.2 mm. long, the herbage green, the leaflets glabrous above; *stems* decumbent, ± 3–4 dm. long, branched at 2–4 nodes preceding the first peduncle; *stipules* 1.2–2.5 mm. long, semiamplexicaul, the triangular-subulate blades reflexed; *leaves* 2–5 cm. long, the lowest shortly petioled, the rest subsessile, with 13–17 oblong-obovate or -elliptic, retuse, flat leaflets 3–8 mm. long; *peduncles* incurved-ascending, (2) 4–6 cm. long; *racemes* rather densely 15–33-flowered, the flowers (sometimes fewer on depauperate, lateral branchlets) early declined, the axis somewhat elongating, 2–5 cm. long in fruit; *bracts* membranous, triangular-subulate, ± 1 mm. long; *pedicels* at anthesis 0.5–0.8 mm. long, early arched out- and downward, in fruit thickened, 1.3–1.6 mm. long, apparently persistent; *bracteoles* 0; *calyx* 2.6–2.7 mm. long, minutely white-puberulent, the subsymmetric disc 0.4–0.5 mm. deep, the tube 1.8–2 mm. long, 1.8–2 mm. in diameter, the triangular-subulate teeth 0.7–0.8 mm. long, the whole becoming papery, marcescent unruptured; *petals* "white," drying yellowish, of nearly equal length; *banner* recurved through ± 40°, obovate-spatulate, shallowly notched, ± 5.3 mm. long, 3.3 mm. wide; *wings* 4.9–5.2 mm. long, the claws 2.1–2.2 mm., the lanceolate blades ± 3.5 mm. long, 1.4 mm. wide, rather abruptly incurved in the distal half; *keel* 5.3 mm. long, the claws 2.3 mm., the half-elliptic blades 3.3 mm. long, 1.9 mm. wide, incurved through 95° to the rather sharply deltoid apex; *anthers* 0.3–0.45 mm. long; *pod* reflexed, very shortly stipitate, the stipe 0.6–0.8 mm. long, concealed by the calyx, the body linear-acuminate in profile, lunately incurved, 1.2–1.4 cm. long, 2.2–2.5 mm. in diameter, cuneate at both ends, cuspidate at apex (the cusp ± 1 mm. long), compressed-triquetrous, carinate ventrally by the suture, grooved dorsally, the lateral faces nearly flat, the lateral angles narrow but obtuse, the thin, very sparsely white-strigulose valves becoming papery, stramineous, prominently reticulate, inflexed as a complete septum ± 1.5 mm. wide; *dehiscence* and *seeds* unknown; *ovules* 10–12.—Collections: typus only.

Open rolling valley in pine forest, 6000–7000 feet, in argillaceous soils, known only from the type-locality in the Sierra Surotato, Sinaloa.—Map No. 51.—August and September.

Astragalus sinaloae (of Sinaloa), sp. nov., *A. ervoideo* H. & A. ut videtur affinis, floribus paullo minoribus, petalis subaequilongis, et leguminc puberulo ab eo facile distinguenda.—Herba perennis, parce strigulosa; *stipulae* liberae; *foliola* 13–17 oblonga; *racemi* densiuscule 15–33-flori; *calyx* campanulatus ± 2.6 mm. longus, dentibus tubo subdimidio brevioribus; *petala* alba subaequilonga, 4.9–5.3 mm. longa; *legumen* brevissime stipitatum reflexum lineari-acuminatum incurvum ± 1.3 cm. longum triquetrim compressum dorso sul-

catum biloculare puberulum.—SINALOA: Sierra Surotato, September 1–10, 1941, *Howard Scott Gentry 6283*.—Holotypus, MICH! isotypi, DS, GH, NY!

The type-collection of *A. sinaloae* was distributed under the name of *A. vaccarum*, a species like it in the tiny, declined flowers and the narrow, hamosoid pod which is, however, truly sessile and deciduous from the receptacle and not stipitate and persistent as in sect. *Miselli*. The nearest ally of *A. sinaloae* is *A. ervoides*, the pod of which is quite similar in structure but glabrous. The flowers of these two species are similar in most fine details, although the slightly shorter petals of the Sinaloa milk-vetch are all of about the same length, giving a peculiar blunt look to the corolla as viewed in profile. The calyx of var. *Maysillesii*, the form of *A. ervoides* geographically nearest to *A. sinaloae*, is two or three times as long, its teeth nearly four times longer.

A specimen of doubtful identity, but evidently representing a close relative or possibly a variant of *A. sinaloae*, has been collected at about 1900 feet in Municipio de Concordia, near Pánuco, Sinaloa (*M. P. Dehesa 1585*, US). The plant differs from *A. sinaloae* as described above in its larger leaflets, looser racemes, slightly shorter, broadly deltoid calyx-teeth, and slightly longer petals, but especially in the glabrous ovary and forming pod. If the description of *A. sinaloae* were expanded to include this form, the species could still be distinguished from *A. ervoides* by its petals of subequal length.

126. ASTRAGALUS CARMINIS

Rather slender, thinly strigulose with straight, appressed hairs up to 0.3–0.5 mm. long, the herbage pale green, the leaflets thin-textured and bicolored, green and glabrous above, pallid or subglaucescent and thinly pubescent beneath; *stems* several or numerous, ascending from the crown of a thick, woody taproot or from a shortly forking caudex, sometimes diffuse and trailing, 1.5–5 dm. long, simple or commonly branched or spurred toward the base; *stipules* thinly herbaceous or submembranous, the lowest becoming papery, 1.5–5 mm. long, the lowest small, deltoid, the upper ones broadly triangular to lance-acuminate, embracing ± ½ the stem's circumference; *leaves* 3–8 (10) cm. long, slender-petioled but the upper ones shortly so, with (13) 17–27 oblong-obovate or obovate-cuneate, retuse or truncate-emarginate, flat leaflets 2–12 mm. long; *peduncles* erect or incurved-ascending, 4–9 cm. long; *racemes* loosely (4) 6–14 (20)-flowered, the flowers widely spreading and in age declined, the axis elongating, 1–6 (8) cm. long in fruit; *bracts* membranous, lanceolate or linear-setaceous, 1–2.5 mm. long, reflexed in age; *pedicels* at anthesis ascending, straight or distally arched outward, 0.5–1.7 mm. long, in fruit more strongly arched, a little thickened, 1–2 mm. long; *bracteoles* 0; *calyx* 4.4–5.3 (5.8) mm. long, loosely black- and white-strigulose, the oblique disc 0.7–0.8 mm. deep, the tube 1.6–3 mm. long, 2–2.6 mm. in diameter, the lanceolate or subulate teeth 1.6–3 (4) mm. long; *petals* bluish- or pinkish-purple, apparently pale; *banner* abruptly recurved through ± 90°, obovate-cuneate, notched, 7.6–10 mm. long, 4.5–6 mm. wide; *wings* (as long or slightly longer) 7.6–10 mm. long, the claws 2.3–3 mm., the linear-oblong or -elliptic, obtuse or erose-undulate, lunately incurved blades 6.4–8 mm. long, 1.5–2 mm. wide; *keel* 6.3–7.5 mm. long, the claws 2.3–3 mm., the broadly half-elliptic blades 4–4.7 mm. long, 2.2–2.5 mm. wide, abruptly incurved through 90–95° to the sharply deltoid, slightly porrect apex; *anthers* 0.4–0.5 mm. long; *pod* declined or (from horizontal peduncles) spreading, the stipe 1–2.7 mm. long, the body linear-oblong in profile, lunately or falcately incurved, 1.2–2.2 cm. long, 2.5–3.5 mm. in diameter, cuneately contracted at both ends, cuspidate at apex, triquetrously compressed, with nearly flat lateral and narrowly sulcate dorsal faces, carinate ventrally by the suture, the lateral angles obtuse, the thin, green, glabrous valves becoming papery, stramineous, delicately cross-reticulate, the complete or almost complete septum 1.1–1.6 mm. wide; *ovules* 12–16; *seeds* brown, smooth but hardly lustrous, 2–2.5 mm. long.—Collections: 7 (o); representative: *Johnston & Mueller 513, 689, 1137* (GH); *R. M. Stewart 1867* (GH).

Streamsides and open slopes among pines and scrub-oaks, about (?) 5000–6500 feet, apparently not uncommon in the mountains of northwestern and western Coahuila (Sierra del Carmen, Sierra del Pino, Sierra Encantada, Sierra Madera, and Sierra Almagre); to be sought in adjoining Chihuahua and possibly in trans-Pecos Texas.—Map No. 51.—Late June to September.

ASTRAGALUS CARMINIS (of Sierra del Carmen) Barneby in Leafl. West. Bot. 7: 37. 1953. —"MEXICO. Coahuila: Cañon de Sentenela on Hacienda Piedra Blanca, Municipio de Villa Acuña, 6 July 1936, *F. Lyle Wynd & C. H. Mueller 556* . . ."—Holotypus, US! isotypi, ARIZ, GH, MO, NY!

Early collections of *A. carminis* were identified and distributed as *A. madrensis,* a species which has turned out to be synonymous with *A. (Micranthi) nothoxys* and therefore easily distinguished by its slenderly acuminate keel-tip and by a pod truly sessile and deciduous from the receptacle. Although far removed geographically from other centers of speciation in its section, *A. carminis* has all technical characters of the *Miselli.* It might be sought among the *Strigulosi,* many of which are also Mexican and flower in the summer and fall months; but these have connate stipules at the base of the stems and (with two allopatric exceptions) a pod either semibilocular or decurved or both. A delicately pretty astragalus, the Carmen milk-vetch is recognized in its region by the rather numerous small leaflets of thin texture, the loose racemes of relatively small, pink flowers, and the narrow, drooping, trigonously compressed, glabrous pods which are more or less strongly incurved into a shallow crescent or sickle. The short stipe, often concealed by the marcescent calyx, is easily overlooked.

127. ASTRAGALUS STRATURENSIS

Slender, diffuse, wiry, strigulose with straight, appressed hairs up to 0.25–0.45 mm. long, the herbage cinereous in youth, the leaflets somewhat bicolored, green and glabrous above, pallid or gray-green beneath, the inflorescence ± black-strigulose; *stems* many, (1.5) 2–3 dm. long, decumbent and ascending from the forking caudex, together forming low, bushy clumps, simple or nearly so, leafless and often purplish at base, green upward, flexuous or zigzag distally; *stipules* thinly herbaceous becoming papery, 1–2.5 mm. long, deltoid or triangular, the lowest amplexicaul-decurrent around ± ¾ the stem's circumference, the rest less strongly cauline, the blades commonly spreading or deflexed; *leaves* 3.5–9.5 cm. long, shortly petioled or the upper ones subsessile, with 11–19 oblong, linear-oblong, rarely oval, obtuse or retuse, commonly folded leaflets 3–13 mm. long; *peduncles* ascending, 1.5–6 (7.5) cm. long; *racemes* loosely 9–25-flowered, the flowers early declined, the axis elongating, arcuate-incurved, (1.5) 3.5–14 cm. long in fruit; *bracts* membranous, ovate, 0.8–1.5 mm. long, black-ciliate; *pedicels* at anthesis ± 1 mm. long, in fruit arched outward, scarcely thickened, 1–1.5 mm. long; *bracteoles* 0; *calyx* 3.5–4.2 mm. long, densely strigulose with black and sometimes a few white hairs, the obconic disc 0.6–0.9 mm. deep, the tube 2.5–3.3 mm. long, 1.9–2.2 mm. in diameter, the broadly subulate teeth 0.9–1.1 mm. long, the whole becoming papery, marcescent unruptured; *petals* bright violet-purple with whitish or sometimes yellowish wing-tips; *banner* recurved through 50–90°, ovate or suborbicular-cuneate, notched, 6.3–8.5 mm. long, 5.1–5.7 mm. wide; *wings* 6.9–8.4 mm. long, the claws 2.3–3 mm., the broadly oblanceolate or obovate, obtuse blades 5.7–7.2 mm. long, 2–2.5 mm. wide; *keel* 5–6 mm. long, the claws 2–3 mm., the obliquely oblong-obovate blades 3–3.4 mm. long, 1.8–2.2 mm. wide, incurved through 100° to the obtuse, sometimes obscurely porrect apex; *anthers* 0.35–0.5 mm. long; *pod* loosely pendulous, stipitate, the stipe 1.4–2 mm. long, the body narrowly oblong-oblanceolate in profile, gently incurved or nearly straight, 1–1.5 cm. long, 2.2–3 mm. in diameter, cuneate at both ends, triquetrously compressed, carinate ventrally by the thickened, salient suture, deeply sulcate dorsally, the lateral angles rounded, the thinly fleshy, green, white-strigulose valves becoming papery, stramineous, finely reticulate, the complete or nearly complete septum

0.8–1 mm. wide; *ovules* 10–13; *seeds* smooth, brown, 2–2.4 mm. long.—Collections: 8 (ii); representative: *Eastwood & Howell 1253* (CAS); *F. W. Gould 1716* (ARIZ, CAS, NY); *Ripley & Barneby 4971, 6362* (CAS, RSA); *Goodding 4796* (ARIZ, RM).

Dry hillsides and ridges, with piñon and juniper, sometimes at the edge of oak thickets, on calcareous clays and gravels, 5000–7050 feet, local but forming colonies, Needle Mountains and Highland Range, Lincoln County, Nevada, east to Cove Fort, Millard County, and the Pine Valley Mountains, Washington County, Utah, and south to Mount Trumbull in Mohave County, Arizona.—Map No. 52. —May and June.

ASTRAGALUS STRATURENSIS (from *stratura*, pavement, perhaps in allusion to the lode at Silver Reef) Jones, Contrib. West. Bot. 8: 19. 1898.—"The type is the writer's specimens from Silver Reef S. Utah, 5000 ft. alt. in gravel, May 5th, 1894 . . . "—Holotypus, *Jones 5175*, POM (3 sheets)! isotypi, NY, RM, US!—*Atelophragma straturense* (Jones) Rydb. in Bull. Torr. Club 55: 162. 1928.

Hamosa atratiformis (resembling *A. atratus*) Rydb. in Bull. Torr. Club 34: 48. 1907.—"SOUTHERN UTAH: 1874, *C. C. Parry 47* . . . "—Holotypus, NY! isotypi, GH, K!—*Tium atratiforme* (Rydb.) Rydb. in N. Amer. Fl. 24: 395. 1929.

The type localities of *A. straturensis* and *H. atratiformis* lie close together in Washington County, Utah. Silver Reef is a mining community on the east slope of the Pine Valley Mountains. Parry stated (in Amer. Nat. 9: 270) that his No. 47, misidentified as *A. atratus*, had been collected at St. George, though most probably at some distance from the village which stands on the floor of the Virgin Valley at the south foot of the Pine Valley range at about 2800 feet. Jones cited Parry's plant as paratypus of *A. straturensis;* yet Rydberg compared his new *Hamosa* only with *A. atratus* from which it is amply distinct. Twenty years later, returning with some asperity to the same theme in a revision of *Tium*, Rydberg remarked that the resemblance between *A. straturensis* and *T. atratiforme* was "superficial, neither the flowers nor the fruits being the same." This opinion was based originally on the fragmentary and immature specimen from St. George, but an element of another species (*Parry 107*, from Arizona) had been introduced in the meantime to confuse the issue. So far as the type-collections go, *A. straturensis* and *H. atratiformis* are unquestionably conspecific.

The Pine Valley milk-vetch, *A. straturensis*, is the only astragalus of its region with a pendulous, stipitate, dorsally grooved pod combined with purple flowers and a perennial root. It should be recognized without difficulty. The flowers are small, of an unusually vivid purple which turns violet in drying, and are often so numerous as to make a considerable show. On close observation, the pallid penciled eye in the fold of the banner and the white or rarely yellowish wing-tips add greatly to the decorative effect of the individual flower.

128. ASTRAGALUS HOWELLI

Of medium stature, with a stout, woody taproot and shortly forking caudex, villosulous throughout with sinuous or curly, sometimes loosely entangled hairs up to 0.5–0.7 mm. long, the herbage greenish-canescent, the leaflets pubescent on both sides but sometimes thinly so above; *stems* several, rather stout and firm, erect and incurved-ascending from the erect or decumbent base, (0.5) 0.8–2 dm. long, composed of ± 3–5 developed internodes; *stipules* papery or early becoming so, 3–5 mm. long, the lowest decurrent around ¾ the stem circumference, the median and upper ones narrower, with lance-ovate blades; *leaves* (4) 5–14 cm. long, the lowest evidently petiolate, the upper very shortly so, with (17) 21–27 (33) oblong, obovate-cuneate, or oblanceolate, obtuse or truncate-retuse, flat or loosely folded leaflets 4–14 mm. long; *peduncles* erect, rather stout, (5.5) 8–18 cm. long, arising from the 1–3 uppermost nodes and surpassing the foliage; *racemes* loosely 10–25-flowered, the flowers early spreading and ultimately nodding, the axis 5–12.5 cm. long in fruit; *bracts* membranous, lance- or ovate-acuminate, (1) 1.5–2.5 mm. long; *pedicels* at anthesis slender, ascending, 1–2.5 mm. long, in fruit ascending, spreading, or deflexed, a little thickened, 2–4.5 mm. long; *bracteoles* 0; *calyx* 5–7.5 mm. long, villosulous like the herbage with white or sometimes a few black

hairs, the disc 0.5–1.2 mm. deep, the tube 3.5–5.7 mm. long, 2.5–3.7 (4) mm. in diameter, the subulate teeth 0.8–2 (2.4) mm. long, the ventral pair often shortest and the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, immaculate; *banner* recurved through 50–85°, oblong-obovate beyond the cuneate claw, 10–16 (16.5) mm. long, 4.4–8 mm. wide; *wings* (as long or a trifle longer) 9.7–15.2 (16.2) mm. long, the claws 4.2–6.7 mm., the obliquely obovate-oblanceolate, obtuse or shallowly emarginate blades 6.1–11.4 mm. long, 2.3–4.1 mm. wide; *keel* 8.2–12 mm. long, the claws 4–6.4 mm., the half-obovate blades 4.5–6.8 mm. long, 2.5–3.5 mm. wide, abruptly incurved through ± 90° to the bluntly deltoid apex; *anthers* 0.5–0.8 mm. long; *pod* pendulous, stipitate, the straight, slender stipe (4) 7–12 (14) mm. long, the body lunately lanceolate or linear-lanceolate in profile, (1.6) 2–3 cm. long, 3–4.5 (5) mm. in diameter, gradually or cuneately contracted at base and more abruptly so distally into a stout, subulate beak 1.5–3 mm. long, the whole trigonously compressed, with plane lateral and openly sulcate dorsal faces, carinate ventrally by the nearly straight or gently concave suture, the lateral angles obtuse, the pale green, densely villosulous valves becoming stramineous, stiffiy papery, the complete septum 2–3 mm. wide; *ovules* (11) 13–21; *seeds* (not seen fully ripe) apparently smooth and brown, ± 2.8–3.8 mm. long.—Collections: 19 (iii); representative: *Peck 26,174* (CAS, RSA, WS); *Cronquist 6286* (ID, NY, RSA, SMU, WS), *7151* (NY, RSA); *Ripley & Barneby 10,820, 10,837* (RSA).

Slopes, ridges and summits of dry grassy hills, in sandy or stiff stony soils overlying basalt, sometimes sheltering under low brush, 1750–3350 feet, locally common in the valleys of the lower John Day and Deschutes Rivers in Wasco and Sherman Counties, Oregon; also apparently somewhat isolated on the headwaters of Bitter and Birch Creeks in eastcentral Morrow and adjoining Umatilla Counties. —Map No. 52.—May and June.

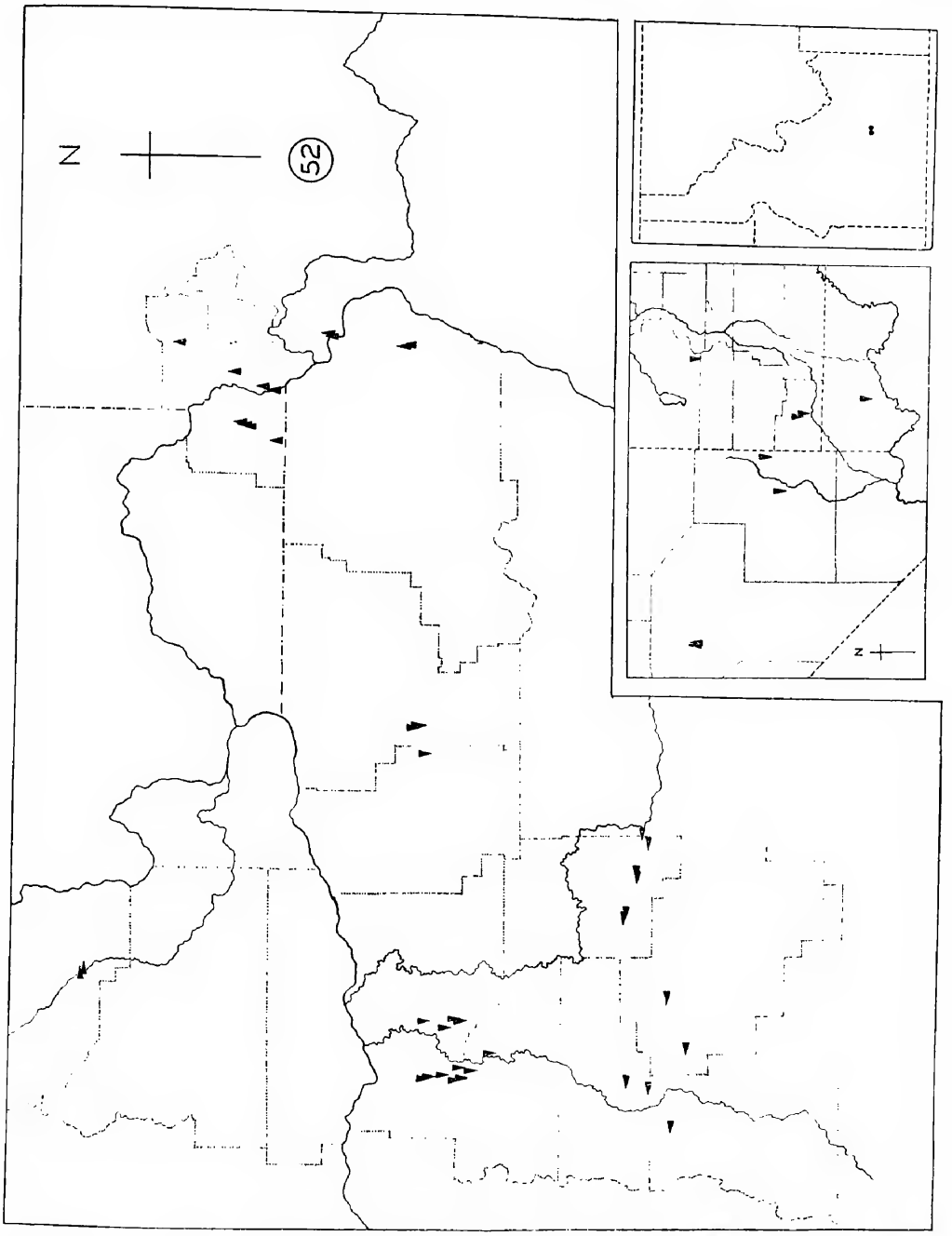
ASTRAGALUS HOWELLI (Joseph Howell, 1830–1912, elder brother and collaborator of Thomas J. Howell) Gray in Proc. Amer. Acad. 15: 46. 1879.—"Wasco County, S. E. Oregon, Joseph Howell."—Holotypus, GH! presumed isotypi, labeled "High prairies, Wasco County, *J. & T. J. Howell in 1879*," NY, ORE! or "Wasco Co., *T. Howell, 1879*." P!—*Tium Howelli* (Gray) Rydb. in N. Amer. Fl. 24: 389. 1929 (*"Howellii"*).

The Howell milk-vetch is locally common in two restricted areas on the southern affluents of the Columbia in transmontane Oregon, with a gap of some seventy miles intervening. The plants of the east focus of abundance (cf. *Schallig 123,* RSA; *Eggleston 12,685,* US; *Cronquist 6286,* already cited), known mostly from young flowering specimens, suggest *A. Arthuri* in their comparatively diffuse or assurgent habit of growth, but even here the pod (so far as known) is shorter and broader, and nearly always fewer-seeded. It seems possible, nevertheless, that these populations may represent a distinct variety of *A. Howelli,* approaching *A. Arthuri* morphologically as well as in a geographic sense.

In the typical form of *A. Howelli* the lower, more vigorous peduncles and racemes-axes together surpass the main stem in length, and the flowers are ordinarily projected well beyond the leaves. The resulting growth-habit is graceful, and the plants are attractive in a modest way. The relationship of the Howell milk-vetch to the closely related *A. misellus* is discussed under the latter species.

129. ASTRAGALUS ARTHURI

Relatively slender, loosely strigulose nearly throughout with narrowly ascending and incumbent, sometimes sinuous hairs up to 0.4–0.6 (0.75) mm. long, the herbage greenish or cinereous, the leaflets glabrous above; *stems* several, simple above the immediate base, 0.2–1.6 (2.6) dm. long, either all short and forming a close leafy tuft on the shortly forking caudex or all better-developed and then diffuse or ascending, composed of 1–5 (6) developed internodes up to 1.5–9 cm. long; *stipules* 2–6 (7) mm. long, thinly herbaceous becoming papery, often purple-tinged, the lowest decurrent around ± ¾ the stem's circumference, usually broader



Map No. 52. Top, parts of Washington, Oregon, and Idaho. Range of *A. Howelli*; of *A. Arthuri*; and of *A. misellus*: var. *misellus*; and var. *pauper*. Lower left, parts of Nevada and Utah. Range of *A. toquimanus*; and of *A. straturensis*. Lower right, Idaho. Range of *A. oniciformis*.

than the triangular-lanceolate or lance-acuminate upper ones; *leaves* slender-petioled or the uppermost subsessile, with (15) 19–25 (27) linear-elliptic, oval, or oblanceolate, obtuse, subacute, truncate-mucronulate, or shallowly retuse, flat or loosely folded leaflets (2) 4–12 (14) mm. long; *peduncles* ascending, often incurved, (7) 10–18 (20) cm. long, well surpassing the foliage; *racemes* loosely

(5) 8–20-flowered, the flowers early horizontal, later declined, the axis becoming (2.5) 5–15 cm. long, the fruits secund; *bracts* membranous or early becoming so, lanceolate, 1.5–3.5 mm. long; *pedicels* slender, at anthesis ascending, (1.5) 2–3 mm. long, in fruit arched outward, or twisted and recurved, little thickened, (2) 2.5–4 mm. long; *bracteoles* usually 0, minute when present; *calyx* 6.6–8.8 mm. long, loosely strigulose with mixed black and white hairs, the disc 0.8–1.3 mm. deep, the deeply campanulate tube 4.5–6 mm. long, (2.5) 2.8–3.8 mm. in diameter, the lance-subulate teeth 1.8–3.5 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, immaculate; *banner* recurved through 50–85°, oblong-ovate beyond the cuneate claw, 11.7–15.2 mm. long, 4.8–8 mm. wide; *wings* (nearly as long or a trifle longer) 11.7–15.2 mm. long, the claws 5.3–6.7 mm., the lunately oblanceolate, obtuse blades 7.3–10 mm. long, 2.2–3.8 mm. wide; *keel* (9.5) 10–11.7 mm. long, the claws 5.3–6.4 mm., the half-obovate blades (4.6) 5–6.3 mm. long, 2.5–3.5 mm. wide, abruptly incurved through 90° to the bluntly deltoid apex; *anthers* 0.55–0.8 mm. long; *pod* pendulous, stipitate, the slender stipe 6–15 mm. long, the linear-ellipsoid body (2.5) 3–4.5 cm. long, 2.5–3.3 mm. in diameter, nearly straight or gently incurved, tapering at base into the stipe and distally into a slender, acuminate beak, laterally compressed-triquetrous, with rounded lateral angles and convex lateral faces, carinate ventrally by the suture, narrowly sulcate dorsally, the thin, greenish, finely and densely strigulose valves becoming papery, stramineous, the complete septum 1.6–2.3 mm. wide; *ovules* (16) 18–30; *seeds* narrowly oblong, dark brown or nearly black, smooth or minutely pitted, sublustrous, 2.5–3.1 mm. long.—Collections: 17 (i); representative: *Constance, Rollins & Dillon 1588* (WS, WTU); *W. H. Baker 9051* (ID, RSA); *Ripley & Barneby 10,769* (CAS, NY, RSA).

Dry grassy hills and stony meadows, on basalt, 900–3100 feet, locally plentiful in the valley of the Snake River and its tributary creeks and rivers about the common boundary-point of Washington (Asotin County), Oregon (northeastern Wallowa County), and Idaho (Nez Perce and Idaho Counties).—Map No. 52. —Mid-April to June.

ASTRAGALUS ARTHURI (Amos Arthur Heller, 1867–1944, botanist, collector, editor of *Muhlenbergia*) Jones, Contrib. West. Bot. 8: 20. 1898.—"Lake Waha, Nez Perce Co., Idaho, 2–3500 ft., May, A. A. and E. Gertrude Heller."—Holotypus, collected June 19, 1896, POM! isotypi, DS, K, MO, ND, NY, P, PH, US, WS!—*Atelophragma Arthuri* (Jones) Rydb. in Bull. Torr. Club 40: 51. 1913. *Tium Arthuri* (Jones) Rydb. in N. Amer. Fl. 24: 388. 1929.

The stems of the Waha milk-vetch, *A. Arthuri,* are ordinarily quite short, composed of few or often only one developed internode, so that the leaves are gathered into a loose basal tuft and the earlier of the long, incurved-ascending peduncles appear subscapose. In protected sites and generally late in the season, the plants become more strongly caulescent, but even then the stems rarely equal in length the longest of the peduncles and racemes together. The extremely long, slender, linear-fusiform pods, which are the particular ornament and most distinctive feature of the species, are formed after the basic fashion of the *Miselli;* but they are less sharply trigonous than those of its close allies, the convex curvature of the lateral faces passing imperceptibly into that of the rounded lateral angles. The fruit-cavity is so narrow that the seeds are compressed into a narrowly oblong figure. Despite the striking modification of the pod *A. Arthuri* is closely related to *A. Howelli,* differing principally in its weaker, more diffuse stems, more nearly appressed vesture, and glabrous upper surface of the leaflets.

About the mouth of the Grande Ronde River and on the opposite bank of the Snake River in Idaho, *A. Arthuri* is common locally in the arid grasslands characteristic of the region. It has been traced up the Snake Canyon to Imnaha Creek and ascends the Clearwater a little way, its known limit in this direction being Myrtle Beach. Its main area of dispersal does not exceed fifty miles in diameter.

130. ASTRAGALUS MISELLUS

Quite slender, with a taproot and shortly forking caudex, finely strigulose with ascending or largely incumbent, straight, curved, or somewhat curly hairs up to

0.35–0.65 mm. long, the herbage yellowish-green or cinereous, the leaflets either glabrous or pubescent above; *stems* several or numerous, simple or rarely branched below the middle, (0.25) 0.5–2.5 dm. long, incurved-ascending or in exposed sites prostrate, commonly tinged with brownish-purple toward the base; *stipules* 1.5–3 mm. long, herbaceous but the lowest becoming firmly papery and brownish, the lowest commonly fully amplexicaul but not (or only very rarely and obscurely) connate, the upper ones semiamplexicaul, with triangular or lanceolate, spreading or deflexed blades; *leaves* (2.5) 3–7 cm. long, petioled but the upper ones shortly so, with 9–21 oblong-obovate to linear-oblong or -elliptic, obtuse, subacute, or (in some lower leaves) retuse, folded or marginally involute leaflets 2–10 mm. long; *peduncles* ascending, (1.5) 2.5–8 (10) cm. long; *racemes* loosely 5–15-flowered, the flowers becoming horizontal and at length declined, the axis (often produced beyond the last flower as a filiform appendage) 1–8 cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–1.5 mm. long; *pedicels* at anthesis 0.8–1.3 mm. long, in fruit arched outward, a little thickened, 1.3–1.7 mm. long; *bracteoles* 0; *calyx* 3.4–4.8 mm. long, pubescent like the herbage with white or mixed black and white hairs, the disc 0.5–0.9 mm. deep, the brownish-purple tube 2.3–2.8 mm. long, 1.8–2.9 mm. in diameter, the subulate teeth (0.9) 1–2.2 mm. long, the whole becoming papery, marcescent unruptured; *petals* yellowish or greenish-ochroleucous, the banner veined with brownish-lilac; *banner* recurved through 45–85°, ovate-cuneate, notched, (6.5) 7–9.5 (10) mm. long, (4) 4.8–7.6 mm. wide; *wings* (6.6) 7–9.5 mm. long, the claws 2–2.8 mm., the obliquely obovate, obtuse or subemarginate blades (4.6) 5–8.1 mm. long, (1.7) 2.4–3.7 mm. wide, both incurved but the left one more abruptly so and further, its blade set at ± 90° to the claw; *keel* 4.6–6.4 mm. long, the claws 2.1–2.8 mm., the obliquely obovate or half-obovate blades 2.6–3.9 mm. long, 1.9–2.6 mm. wide, abruptly incurved through 110–130° to the bluntly deltoid apex; *anthers* (0.35) 0.4–0.6 mm. long; *pod* pendulous, stipitate, the stipe 2.5–5 mm. long, the body lunately lance-elliptic in profile, 1.2–2.5 cm. long, 2.6–4 mm. in diameter, tapering at both ends, cuspidate at apex, triquetrously compressed with flat lateral and openly sulcate dorsal faces, the thin, greenish, densely strigulose-villosulous valves becoming papery, brownish-stramineous, the complete septum 1.3–2.4 mm. wide; *ovules* 11–17; *seeds* brown, minutely pitted, dull, 2.2–2.7 mm. long.

Key to the Varieties of A. misellus

1. Stems mostly 1–2.5 dm. long; *leaflets* (9) 13–21, glabrous above or nearly so; n.-w. transmontane Oregon ..... 130a. var. *misellus*
1. Stems 2.5–7 cm. long; *leaflets* (7) 11–13, pubescent above; Yakima Valley, Washington ..... 130b. var. *pauper*

130a. Astragalus misellus var. misellus

Leaves 2.5–6.5 cm. long, the leaflets comparatively crowded; otherwise as given in the key.—Collections: 16 (ii); representative: *Cusick 1690* (ND, ORE, WS), *2632* (ND, NY, POM); *Peck 10,101* (NY, WILLU, WSC), *13,810* (WILLU), *24,141* (WILLU); *Cronquist 7026, 7169* (NY, RSA); *Ripley & Barneby 9511* (CAS, NY, RSA, UTC).

Stony pastures and gravelly clay banks, on basaltic bedrock, 1100–3700 feet, locally plentiful on the upper forks of the Deschutes and John Day Rivers in Deschutes, Wheeler, Crook, Jefferson, and Grant Counties, Oregon.—Map No. 52. —May to July.

Astragalus misellus (poor or wretched) Wats. in Proc. Amer. Acad. 21: 449. 1886.—"Collected near Mitchell, Wasco County, Oregon; Thomas Howell, May, 1885."—Holotypus, dated "May 15, 1885," actually from Wheeler County, GH! isotypi, dated "May 14, 1885," some numbered *374*, G, NY (3 sheets), ORE, P, WS, WTU!—*Phaca misella* (Wats.) Piper in

Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 371. 1906. *Astragalus Howelli* var. *misellus* (Wats.) Jones, Rev. Astrag. 262, Pl. 66, 67. 1923. *Tium misellum* (Wats.) Rydb. in N. Amer. Fl. 24: 389. 1929.

Astragalus drepanolobus var. *aberrans* (differing gravely from *A. drepanolobus*) Jones, Contrib. West. Bot. 10: 64. 1902.—"Columbia Basin."—Holotypus, *Leiberg 322*, the only spm. so annotated by Jones, collected June 25, 1894, between Prineville and Bear Buttes, 1100 m., Crook County, Oregon, POM! isotypi, CAS, NY, ORE, P, US!—*A. Howelli* var. *aberrans* (Jones) C. L. Hitchc. in Univ. Wash. Pub. Biol. 17: 239. 1961.

The pauper milk-vetch, *A. misellus*, is closely related to *A. Howelli*. The two species are vicariant in range, and their pods are essentially alike in form, but *A. misellus* has smaller flowers, shorter peduncles, fewer leaflets, and a fruit elevated on a much shorter stipe. The average plant of *A. misellus* is more diffuse in habit than the average plant of *A. Howelli*, and the pubescence is in almost all plants more nearly appressed and strigulose. It might nevertheless be preferable to follow Jones and Hitchcock and regard the pair as varieties of one species, but if we expand *A. Howelli* in one direction to include *A. misellus* var. *pauper*, it would be illogical not to include *A. Arthuri* and possibly also *A. oniciformis*. The discontinuities between these kindred species are of about the same magnitude, but so far as known at present they are absolute, for there are no specimens of really doubtful identity.

The range of *A. misellus* as given by Jones probably includes that of var. *pauper*. I have not found the basis of his record (1923, p. 263) from Pasco (Franklin County, Washington), nor that from the mysterious "Bruno River, Oregon."

130b. Astragalus misellus var. pauper

Leaves 3–7 cm. long, the leaflets relatively distant and scattered; otherwise as given in the key.—Collections: 3 (o); representative: *Whited 84* (US), *291* (WS).

Habitat not recorded, but to be sought in sagebrush scabland at ± 1500 feet, known only from the neighborhood of Ellensburg, Kittitas County, Washington.—Map No. 52.—April to early June.

Astragalus misellus var. pauper (poor), var. nov., a var. *misello* caulibus abbreviatis 1 dm. haud attingentibus, foliolisque paucis (plerumque 11–13, nec 13–21) absimilis.—Washington: Ellensburg, Kittitas County, May 20, 1897, *C. V. Piper 2681*.—Holotypus, NY! isotypus WS!

The var. *pauper* has all essential features of its species so far as flowers and fruits are concerned, but it is a dwarfer plant than var. *misellus*, recalling *A. (Reventi-arrecti) obscurus* or *A. (Atrati) salmonis* in general habit of growth. As compared with the average plant of var. *misellus*, the flowers are fewer (mostly 5–10), the stems and herbage are cinereous with slightly longer hairs, and the leaflets are more distantly arranged along the rachis and cinereous on both sides.

131. Astragalus oniciformis

Slender but wiry, diffuse, perennial, with a taproot and at length loosely forking, suffruticulose caudex, loosely strigulose or subvillosulous with incumbent or ascending, nearly straight or sinuous hairs up to 0.35–0.5 (0.6) mm. long, the herbage greenish-cinereous, the leaflets glabrous or medially glabrescent above; *stems* several or numerous, decumbent or prostrate, (0.5) 1–2.5 dm. long, commonly spurred at the lowest nodes and thence floriferous upward from all succeeding axils; *stipules* papery-membranous or early becoming so, 1.5–3.5 (4) mm. long, triangular or triangular-acuminate, decurrent around half, or the lowest around the whole stem's circumference but not connate; *leaves* 2.5–7.5 cm. long, shortly petioled or the upper ones subsessile, with stiff but slender rachis and (13) 17–25 (27) rather distant, scattered, narrowly to broadly elliptic, oval, or oblong, obtuse or retuse, mostly folded leaflets 1–6.5 mm. long; *peduncles* 0.5–2.5 cm. long, much shorter than the leaves; *racemes* very loosely (4) 6–12-flowered, the flowers early nodding, the axis becoming 1–7 cm. long in fruit, usually produced beyond the last flower as a subulate appendage; *bracts* papery-membranous, ovate or lanceolate, 0.5–1.8 mm. long; *pedicels* filiform, very early arched outward or

ultimately recurved, at anthesis 1–1.4 mm., in fruit 1–1.6 mm. long, tardily disjointing with the fruit; *bracteoles* 0; *calyx* 2.9–3.8 mm. long, strigulose-villosulous like the herbage with white or some dark hairs, the subsymmetric disc 0.6 mm. deep, the campanulate tube 2.1–2.3 mm. long, 1.7–2 mm. in diameter, the subulate teeth 0.8–1.5 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, the banner veined with dull brownish-lilac; *banner* abruptly recurved through 90° or sometimes further, broadly obovate-cuneate, 5.3–6.8 mm. long, 4–5.4 mm. wide; *wings* (0.7 mm. longer to 0.7 mm. shorter than the banner) 5.7–6.8 mm. long, the claws 2–2.5 mm., the oblong-obovate, obtuse blades 4–4.4 mm. long, 1.9–2.9 mm. wide, both incurved but the left one further and more abruptly than the right; *keel* 4–5 mm. long, the claws 1.8–2.3 mm., the half-circular blades 2.4–3 mm. long, 1.7–1.9 mm. wide, abruptly incurved through 110–130° to the deltoid, often obscurely porrect apex; *anthers* 0.35–0.5 mm. long; *pod* pendulous, stipitate, the stipe (1.5) 2–4 mm. long, the body lance- or oblong-ellipsoid, usually a trifle incurved, 7–12 mm. long, (2) 2.5–3.5 (3.8) mm. in diameter, cuneate at both ends or truncately contracted at base into the stipe, cuspidate at apex, triquetrously compressed with nearly flat lateral and openly sulcate dorsal faces, keeled ventrally by the prominent suture, the thin, green but rather densely strigulose valves becoming papery, stramineous, delicately cross-reticulate, inflexed as a not quite complete septum 0.7–1.2 mm. wide; *dehiscence* apical and through the ventral suture; *ovules* 6–12; *seeds* brown or greenish-brown, sometimes purple-speckled, smooth but dull, 1.5–1.8 mm. long.—Collections: 4 (i); representative: *Nelson & Macbride 2987* (CAS, GH, MO, NY); *R. J. Davis 3088* (IDS).

Sandy flats and hollows among boulders, sometimes with sagebrush, on basalt, 4750–4900 feet, known only from a restricted area in the foothills of the Sawtooth Range, around Carey and Picabo, Blaine County, Idaho.—Map No. 52.—May to July.

ASTRAGALUS ONICIFORMIS (resembling *A. Mulfordae,* referred by Rydberg to the genus *Onix*) Barneby in Leafl. West. Bot. 8: 122. 1957.—"IDAHO: . . . Blaine County . . . elevation 4750 ft., east of Picabo, 21 June 1947, fl. & fr., *Ripley & Barneby 8795* . . ."—Holotypus, CAS! isotypi, IDS, NY, RM, RSA, UTC, WTU!

The Picabo milk-vetch, *A. oniciformis,* is a puzzling species, introduced at this point on account of its technical similarity to *A. misellus,* although in many important features of its anatomy and deportment more suggestive of *A. Mulfordae* of the following section. The shortness of the peduncle in relation to the elongate, distantly flowered raceme-axis, and the tiny flowers with unequally incurved wings are particularly suggestive of sect. *Neonix,* although the free stipules are at variance with the circumscription of that group. The likeness to *A. Mulfordae* is immediately striking, but on close observation *A. oniciformis* is found to differ in several fine details other than the stipules, as brought out in the following key:

1. Vesture of sinuous or incurved hairs; *petals* ochroleucous, the banner veined with brownish-purple; *leaflets* oblong-elliptic, all jointed; *body* of the pod 6–12 mm. long; *ovules* 6–12; *seeds* 1.5–1.8 mm. long; Blaine County, Idaho, at ± 4800 ft. elevation ..... *A. oniciformis*

1. Vesture of appresed, straight hairs; *petals* white; *leaflets* mostly linear, the terminal one of some upper leaves nearly always continuous with the rachis; *body* of the pod (9) 10–16 mm. long; *ovules* (11) 12–16; *seeds* 2–2.6 mm. long; Washington and Ada Counties, Idaho, and adjoining Oregon, at 2200–2800 ft. elevation ..... *A. Mulfordae*

132. ASTRAGALUS TOQUIMANUS

Slender, wiry, strigulose nearly throughout with fine, appressed hairs up to 0.2–0.5 mm. long, the herbage greenish or cinereous when young, the leaflets sometimes glabrescent above in age; *stems* several or numerous, incurved-ascending

from the shortly forking caudex, 7–25 (30) cm. long, simple, purplish at base, flexuous distally; *stipules* 1.5–3 mm. long, deltoid or triangular, firm, purplish, the lowest becoming papery and brownish, decurrent around ± ¾ the stem's circumference, the upper ones narrower; *leaves* (2.5) 4–11 cm. long, all petioled but the uppermost shortly so, with 9–17 oblong-oblanceolate or linear-oblong, or (in some lower leaves) obovate, obtuse or retuse, mostly folded and backwardly arched leaflets 3–15 mm. long; *peduncles* incurved-ascending, sometimes becoming divaricate and incurved, 2.5–6 (10) cm. long; *racemes* loosely 9–20-flowered, the flowers early spreading and then declined, the axis elongating, 4.5–13 cm. long, the fruits laxly secund; *bracts* membranous, purplish, ovate or lanceolate, 1–1.5 mm. long; *pedicels* at anthesis 0.5–0.8 mm. long, in fruit arched outward and 1–2 mm. long; *bracteoles* commonly 2, minute; calyx 3.5–4 mm. long, shortly black and white-strigulose, the disc 0.5–0.8 mm. deep, the tube 2.5–2.8 mm. long, 1.8–2.3 mm. in diameter, the broadly subulate teeth 1–1.5 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, veined and distally suffused with dull lilac; *banner* recurved through ± 90°, ovate-cuneate or subflabellate, notched, 6.9–7.6 mm. long, 4.5–6 mm. wide; *wings* 7–7.9 mm. long, the claws 2.5–3.5 mm., the oblong-obovate or broadly oblanceolate, obtuse, lunately incurved blades 4.8–5.5 mm. long, 1.8–2.2 mm. wide; *keel* 6.8–7.7 mm. long, the claws 3–3.5 mm., the blades 4–4.7 mm. long, ± 2.2 mm. wide, straight or nearly so in the proximal half and thereafter abruptly incurved through ± 100° to the narrowly triangular, subacute apex; *anthers* 0.4–0.45 mm. long; *pod* pendulous, stipitate, the slender stipe 3–4 mm. long, the body narrowly oblong-oblanceolate in profile, gently incurved, 1.8–2.5 cm. long, 3.5–4.5 mm. in diameter, cuneate or tapering at base, abruptly acute and mucronulate at apex, sharply triquetrous, with flat lateral and depressed, openly sulcate dorsal faces, the thin, glabrous, mottled but glaucescent valves becoming papery, stramineous faintly purple-tinged, finely cross-reticulate, the complete septum 1.4–1.9 mm. wide; *ovules* 11–16; *seeds* purplish-brown, rugulose, 2.4–2.7 mm. long.—Collections: 3 (iii); representative: *Ripley & Barneby 3996* (CAS, NY, RSA), *in May, 1944* (RSA).

Gravelly hillsides and benches among piñons and junipers, in stiff calcareous soil, often taking shelter under and entangled with low sagebrush, locally plentiful in the type-locality at about 7000 feet on the east slope of the Toquima Range, Nye County, Nevada.—Map No. 52.—Late April to early July.

ASTRAGALUS TOQUIMANUS (of Toquima Range) Barneby in Leafl. West. Bot. 3: 111, Pl. opp. p. 108, fig. D. 1942.—"NEVADA: in a canyon of the Toquima Range about six miles east of Manhattan, Nye Co., alt. 7000 ft., 1 June 1941, fl. & fr., *Ripley & Barneby No. 3692* ..." —Holotypus, CAS! isotypus, RSA!

The Toquima milk-vetch resembles *A. Howelli* and *A. misellus* in the form of the pod, but it differs from the first in its fewer leaflets and smaller flowers of a dingy purple hue, from the latter in its more erect habit of growth, and from both in the truly appressed vesture, little-graduated petals, triangular keel-tip, and glabrous, mottled pod. The related species geographically nearest to *A. toquimanus,* but still some 150 miles distant in a southeasterly direction, is *A. straturensis.* This, however, is easily distinguished by its bright violet-purple petals with obtusely rounded keel-tip and by the narrower, usually shorter, green but strigulose pod. The glaucescence and mottling of the pod-valves and the relative proportions of the petals are not matched elsewhere among the *Miselli* and are suggestive of *A. bernardinus* of sect. *Leptocarpi.* In this species, however, the pod is held erect and eventually disjoints from a short, stipelike gynophore.

Because of the small size and lurid coloring of the flowers *A. toquimanus* is one of the least showy of our desert astragali; the delicately shaped and colored fruits are, nevertheless, quietly attractive. The majority of plants observed in the type-locality were growing up through sagebrush *(Artemisia arbuscula)* or other low shrubs, from which it was difficult to extract an uninjured specimen. The species is to be sought elsewhere on the limestones of central Nevada.

XXXII. Sectio NEVINIANI

Caulescent perennials, with superficial (unless sand-drifted) root-crown; *vesture* basifixed, villous-tomentulose or -pannose; *stipules* free; *leaves* imparipinnate, with 11–29 leaflets; *racemes* ± 15–30-flowered, the ascending or spreading flowers of moderate size, the banner 10.5–17.5 mm. long; *pedicels* thickened in age, persistent or tardily disjointing with the fruit; *calyx-tube* campanulate, sometimes deeply so; *petals* ochroleucous drying pale yellow, regularly graduated, the banner recurved through ± 30–40°, the keel-tip obtuse; *pod* variably oriented to the peduncle but essentially pendulous, stipitate, the body slenderly and obliquely oblong-ellipsoid, ± incurved, contracted at apex into a cuspidate point, triquetrously compressed, grooved dorsally, bilocular or nearly so, the thinly fleshy valves becoming leathery or stiffly papery; *dehiscence* not seen, tardy, probably apical; *ovules* 12–20.—Spp. 2, maritime xerophytes of the seaward islands off the southern California coast.

ASTRAGALUS sect. NEVINIANI, sect. nov., *Misellis* fere omnino similibus forsan nimium affines sed floribus majusculis ad anthesin adscendentibus (nec mox declinatis), indumento villoso-tomentuloso vel -pannoso, leguminis textura primum subcarnosa demum subcoriacea, necnon patria in maritimis insularum oceanicarum arenis ut videtur remoti.—Sp. typica: *A. Nevinii* Gray.

The present section has little to recommend it from the purely technical point of view, and it could perhaps be merged without loss in sect. *Miselli,* from which it is distinguished by feeble differential characters. The two constituent species, which are closely related to each other, were associated by Jones (1923, p. 264) and by Rydberg (1931, p. 399) with *A. (Miselli) Howelli* and its near kindred, all of which have essentially the same pod-structure and a flower hardly different in form or proportion of its parts. But as Rydberg remarked, the *Neviniani* have an individual facies, due to their soft villous-tomentulose vesture, which resembles in quality that of other maritime and insular species of the piptoloboid sects. *Anemophili* and *Densifolii.* Furthermore, the flower ascends from the raceme until anthesis is well advanced or even past, and does not nod in late bud as that of most *Miselli;* and the pod is of thicker texture, distinctly even though only thinly fleshy when first formed, drying to a leathery or stiffly papery consistency. The habitat on ocean bluffs and dunes on the outer islands off the California coast and the lack of any close kindred on the parts of the mainland harboring insular floristic elements together suggest that the *Neviniani* have enjoyed a long period of isolation and divergent evolution. According to Raven ("Flora of San Clemente Island" in Aliso 5: 289–347), Santa Barbara and San Nicolas Islands were submerged during late Pleistocene time, so that *A. Traskiae* must either have reached these islands recently from a refugium where it is now extinct or be of recent and autochthonous origin. On the other hand, parts of San Clemente have been above water from late Tertiary onward, but neither joined to the mainland nor to other islands. Possibly the precursor of the two *Neviniani* survived the pluvial periods on a reduced San Clemente Island, in which case *A. Traskiae* must represent a modern, slightly modified immigrant to the newly emersed islands to the north.

Key to the Species of Sect. Neviniani

1. Leaflets 21–29; *banner* 14.2–17.5 mm., *keel* 10.2–12.9 mm. long; *ovary* and *pod* villous-tomentulose; Santa Barbara and San Nicolas Islands ..... 113. *A. Traskiae*
1. Leaflets 11–25; *banner* 10.6–13 mm., *keel* 9–10 mm. long; *ovary* and *pod* glabrous; San Clemente Island ..... 134. *A. Nevinii*

133. ASTRAGALUS TRASKIAE

Diffuse, leafy, perennial, with a woody taproot and superficial root-crown or caudex (sometimes buried in drifting sand), densely villous-tomentulose throughout with extremely fine, contorted and entangled, together with some few straighter, widely ascending hairs up to 0.7–1 mm. long, the stems white-pannose, the herbage canescent, the leaflets equally pubescent on both sides, the inflorescence largely or wholly fuscous-pubescent; *stems* several, decumbent and ascending, (0.8) 1.5–2 (4) dm. long, branched at base and bearing short, leafy spurs at nearly all nodes preceding the first peduncle, together forming low, mounded clumps; *stipules*

deltoid or triangular-acuminate, 1.5–4 mm. long, semiamplexicaul, densely pubescent dorsally; *leaves* (4) 5–10 cm. long, all petioled, with 21–29 ovate, obovate, oval, or oblong-elliptic, obtuse or emarginate, flat, dorsally keeled leaflets (2.5) 5–15 mm. long, diminishing upward along the rachis; *peduncles* 4–14 cm. long, at anthesis ascending, weighed down by the fruit and then drooping or humistrate, either longer or shorter than the leaf; *racemes* loosely (or at first densely) 12–30-flowered, the axis more or less elongating, 2.5–8 cm. long in fruit; *bracts* submembranous, lance-subulate, 1.5–2 mm. long; *pedicels* at anthesis ascending, rather stout, in fruit either ascending or spreading, 1–1.5 mm. long; *bracteoles* commonly 2, sometimes minute or hairlike; *calyx* 7.5–9 mm. long, the slightly oblique disc 1.3–1.5 mm. deep, the deeply campanulate tube 5.2–6.2 mm. long, 3.5–4 mm. in diameter, the broadly subulate teeth 2.3–3.5 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, concolorous, drying yellowish; *banner* oblanceolate or rhombic-elliptic, shallowly notched, 14.2–17.5 mm. long, 6–8.2 mm. wide; *wings* 12.2–14.5 mm. long, the claws 6.5–7.1 mm., the oblong or oblong-oblanceolate, straight or nearly straight, obtuse, truncate, or obliquely emarginate blades 7.2–8.9 mm. long, 2.1–2.6 mm. wide; *keel* 10.2–12.9 mm. long, the claws 6.7–7.4 mm., the half-obovate blades 5.2–6.1 mm. long, 2.6–2.9 mm. wide, incurved through about 85° to the bluntly deltoid apex; *anthers* 0.5–0.6 mm. long; *pod* essentially pendulous and vertical, spreading or even ascending from horizontal or humistrate peduncles, the straight, slender stipe 4–8.5 mm. long, the body obliquely lance-oblong, half-oval, or half-elliptic in profile, very slightly incurved, 8–16 mm. long, 3.2–5.5 mm. in diameter, broadly cuneate or subtruncate at base, contracted distally into a stout, rigid, subulate beak 1.5–4.5 mm. long, triquetrously compressed with obtuse angles, carinate ventrally by the thickened, straight or slightly incurved suture, openly grooved dorsally, the thinly fleshy, villous-tomentulose valves becoming greenish-stramineous, leathery, transversely reticulate, inflexed as a complete or almost complete septum 1.1–1.8 mm. wide; *ovules* 12–16; *seeds* (not seen ripe) ± 2 mm. long.—Collections: 4 (o); representative: *Trask* (from Santa Barbara Island) *in 1901* (ND); *Moran 826* (CAS, DS); *Dr. Laye Miller* (from San Nicolas Island) *in 1938* (SBM).

Sandy windswept ocean bluffs, gullied banks, and coastal dunes, up to 650 feet, known only from San Nicolas and Santa Barbara Islands off the coast of southern California.—Map No. 109.—March to July, probably intermittently through the year.

ASTRAGALUS TRASKIAE (Luella Blanche Engle Trask, 1865–1916, pioneer explorer of California's insular flora) Eastw. in Proc. Calif. Acad. Sci. III, 1: 102, Pl. VIII, fig. 6. 1898.—"San Nicolas Island . . . collected in April, 1897, by Mrs. Blanche Trask . . ."—Holotypus, CAS! isotypi, MO, POM!—*A. Nevinii* var. *Traskiae* (Eastw.) Jones, Contrib. West. Bot. 10: 87. 1902 (*"Traskae"*). *Tium Traskiae* (Eastw.) Rydb. in N. Amer. Fl. 24: 390. 1929.

The Trask milk-vetch has been reported from Anacapa (Abrams, 1944, p. 591) and San Clemente Islands (Eastwood in Leafl. West. Bot. 3: 66), but is known to me through concrete specimens only from San Nicolas and Santa Barbara, where it is the only perennial astragalus. The San Clemente record was probably based on material of the closely related and endemic *A. Nevinii*, a species very similar in its tomentose vesture and habit of growth but differing in its smaller flowers, fewer leaflets, and glabrous pod. The Anacapa record has not been traced to the source but very likely originated, like that of *A. Nevinii* from the same island, through misidentified flowering material of *A. miguelensis*. The latter, common on Anacapa, superficially resembles the *Neviniani* in its white-woolly foliage and yellowish flowers, but may be distinguished even at anthesis by the connate stipules and later by the sessile, inflated, essentially unilocular pod.

The Trask and Nevin milk-vetches are copy-book examples of insular endemism and of divergent evolution presumably of an orthogenetic type; their close interrelationship is self-evident and has never been disputed. At one point Jones reduced *A. Traskiae* to varietal rank, but he subsequently restored it (1923, p. 264) to that of species, to which its differential

characters fully entitle it. Jepson has interpreted the two species as forming one variable entity and described (1936, p. 369) the pod as "puberulent to tomentulose, glabrate"; but this apparent simplification only serves to conceal the more complex and more interesting facts.

134. Astragalus Nevinii

Perennial but apparently flowering the first season, at length forming bushy plants up to 3–4 dm. tall, softly villosulous throughout with fine, contorted and some straighter or simply incumbent hairs up to 0.6–0.9 mm. long, the stems canescently tomentulose, the herbage greenish-canescent, the leaflets equally pubescent on both sides; *stems* of the year 8–30 cm. long, bushy-branched, becoming indurated at base, apparently diffuse and ascending, erect only in young plants; *stipules* 2–5 mm. long, the lowest becoming papery, deltoid-triangular, the longer upper ones semiamplexicaul, with lanceolate or lance-acuminate blades, pubescent dorsally (sometimes with black hairs) but less densely so than the stem; *leaves* 2–8 cm. long (or on some lateral spurs shorter), petioled but the uppermost shortly so, with 11–25 oblong-obovate, -elliptic, or -oblanceolate, very obtuse or retuse, flat leaflets (1.5) 3–12 mm. long; *peduncles* slender, ascending, perhaps humistrate in age, 6–12 cm. long, equaling or commonly surpassing the leaf; *racemes* shortly and rather densely (15) 20–30-flowered, the flowers declined in age, the axis a little elongating, 2–4 cm. long in fruit; *bracts* submembranous, pallid, linear-lanceolate, 1.5–3 mm. long, decurved in fruit; *pedicels* at anthesis 0.5–1 mm. long, in fruit arched outward, thickened, 0.6–2 mm. long; *bracteoles* 0–2; *calyx* 5.7–6.4 mm. long, villosulous like the herbage with white or mixed white and fuscous hairs, the scarcely oblique disc 0.6–0.9 mm. deep, the deeply campanulate tube 3.8–4.5 mm. long, 2.5–3 mm. in diameter, the broadly subulate or lanceolate teeth 1.4–2.4 mm. long, the whole becoming papery, marcescent unruptured; *petals* "pale-yellow," immaculate; *banner* broadly rhombic or broadly ovate-cuneate, shallowly notched, 10.6–12.7 mm. long, 6.6–8.7 mm. wide; *wings* 10.2–11.3 mm. long, the claws 4.9–5.3 mm., the narrowly oblong or narrowly oblong-oblanceolate, truncate or obliquely emarginate, nearly straight blades 6.3–7.3 mm. long, 1.6–2.2 mm. wide; *keel* 9–10 mm. long, the claws 5–5.5 mm., the half-obovate blades 4.3–5 mm. long, 2.2–2.5 mm. wide, incurved through 85–95° to the bluntly deltoid apex; *anthers* 0.5–0.6 mm. long; *pod* pendulous, stipitate, the slender stipe 4.5–9.5 mm. long, the obliquely narrow-ellipsoid body 1.4–2 cm. long, 3–5 mm. in diameter, cuneate at base, contracted at apex into a stout, obconic, cusplike beak ± 1.5 mm. long, lunately incurved, triquetrously compressed, carinate ventrally by the salient suture, openly but deeply grooved dorsally, the lateral faces nearly flat, the green, thinly fleshy, glabrous valves becoming brownish-stramineous, stiffly papery, prominently reticulate, inflexed as a nearly complete septum 1–1.3 mm. wide; *ovules* 16–20; *seeds* unknown.—Collections:—6 (o); representative: *Trask 279* (NY); *Murbarger 124* (UC); *Raven 17,624* (CAS).

Sandy flats and dunes, or sandy bluffs, on and near the shore, known only from San Clemente Island off the southern California Coast, according to Raven (in Aliso 5: 325) common on the north, west, and south sides of the islands, often associated with *A. miguelensis* but less abundant.—Map No. 109.—February to July, perhaps intermittently through the year.

Astragalus Nevinii (Joseph Cook Nevin, 1835–1913, China missionary, resident in Los Angeles from 1877) Gray in Proc. Amer. Acad. 21: 412. 1886.—"Island of San Clemente off Southern California, Messrs. *Nevin* and *Lyon*, April, 1885."—Holotypus, GH! isotypi, MO, POM (fragm.)!—*Tium Nevinii* (Gray) Rydb. in N. Amer. Fl. 24: 390. 1929.

The Nevin milk-vetch, evidently endemic to San Clemente, has been reported from other Channel Islands, from Anacapa by Jepson (1936, p. 369) and from Catalina by Davidson (Fl. S. Calif. 195), and these records were repeated in Eastwood's island list (in Leafl. West.

Bot. 3: 65). No confirming material exists in the California herbaria, and none was known to Abrams (1944) or to Raven (1963, op. cit.). The specimen from Anacapa (*Hemphill*, UC) cited by Jepson represents *A. miguelensis*. None of the tomentose maritime astragali is known to occur on Catalina.

XXXIII. Sectio NEONIX

Low, slender, caulescent, perennial, with taproot and superficial, often at length suffruticulose caudex; *vesture* basifixed; *stipules* all or at least the lowest ones, connate; *leaves* imparipinnate, with about 15-27 small leaflets, the terminal one in some upper (or all) leaves either jointed or decurrent; *flowers* loosely or remotely racemose, rather few (5–19), small, the banner 5–8.2 mm. long; *pedicels* in fruit scarcely thickened, tardily disjointing with the fruit; *calyx-tube* campanulate; *petals* whitish or ochroleucous, sometimes lilac-veined, regularly but not strongly graduated, the wings sometimes as long or a trifle longer than the banner, the left one more strongly incurved than the right, the keel-tip deltoid; *pod* pendulous or deflexed, stipitate or subsessile, persistent on the receptacle, the body symmetrically or lunately oblong-elliptic or half-elliptic in profile, triquetrous or compressed-triquetrous, fully or subbilocular, the valves papery; *dehiscense* apical and downward through the ventral suture, the walls of the septum also separating in age; *ovules* 6–17.—Spp. 3, xerophytes, of intermontane United States (central transmontane California to interior Oregon and southwestern Idaho).

ASTRAGALUS sect. NEONIX, sect. nov., omnibus fere notulis cum *Misellis* parvifloris congruens nisi stipulis (saltem infimis) inter se alte connatis cito diagnoscenda. Species ultima *(A. Peckii)* legumine parvo, subsessili, compresso *Chaetodontes* parvifloros (praesertim subsect. *Lentiformes*) refert, sed legumen saepe minutim stipitatum cum receptaculo ut videtur haud disarticulatur.—Sp. typica: *A. Mulfordae* Jones.—*Onix* sens. Rydb., 1929, p. 415; 1930, p. 232, Pl. XVI, fig. W.; non Medic.

The section *Neonix* is introduced here in order to emphasize the close relationship of the sectional typus, *A. Mulfordae,* to *A. (Miselli) oniciformis,* a species differing importantly only in the free stipules, and through the latter to *A. misellus,* with which it was associated by Jones (1923, p. 203, Pl. 67). The two members of sect. *Neonix* first in order are near relatives, but *A. Peckii,* with its very small pod greatly compressed laterally and almost sessile, is reminiscent of some small-flowered *Chaetodontes,* especially *A. lentiformis,* and is perhaps misplaced. It was referred by Rydberg to his sect. *Lentiformes* (1929, p. 453), but its pod seems to fall together with the deciduous pedicel rather than disjoint from the receptacle, in this respect agreeing more nearly with the emmenoloboid *Neonix.* As is always the case with pods of very small size and light weight, some doubt remains as to the mode of fall until this can be observed in the field and at full maturity. Possibly, also, I have attached undeserved importance to the united stipules and emmenoloboid pod, features which, despite their obvious pragmatic value (and presumed phylogenetic significance) in many groups of the genus, are by no means universally sovereign. The section *Neonix,* and in particular *A. Peckii,* will require re-evaluation in the light of the number and morphology of the chromosomes.

The name *Neonix* was suggested by Rydberg's reference (l.c.) of *A. Mulfordae* to *Onix* Medic., a monotypic genus (= *Astragalus* sect. *Galegiformis* Gontsch.) proposed to accommodate the Caucasian *A. galegiformis* L., a coarse, tall, leafy species with pods accidentally similar to those of *A. Mulfordae* in shape, texture, and internal structure, but differing greatly in habit of growth, free stipules, and larger and differently proportioned flowers.

Key to the Species of sect. Neonix

1. Pod stipitate, the stipe 0.5–5 mm. long, the body triquetrous, with dorsal, openly and shallowly sulcate face about as broad as the nearly plane lateral faces; *leaflets* (13) 15–25, the terminal one jointed or, if decurrent, then the stipe at least 3 mm. long and the ovules 11–17; either centr. transmontane California or s.-w. Idaho and immediately adjoining Oregon (2)
2. Stipules dimorphic, the lowest connate-sheathing, the upper ones free; *banner* 6.2–8.2 mm., keel 4.7–5.7 mm. long; *stipe* of the pod 3–5 mm., the body (9) 10–16 mm. long; *ovules* 11–17; *leaves* (2.5) 4.5–10.5 cm. long, the terminal leaflet of some leaves commonly decurrent; s.-w. Idaho and immediately adjoining Oregon, below 3000 ft. elevation ..... 135. *A. Mulfordae*

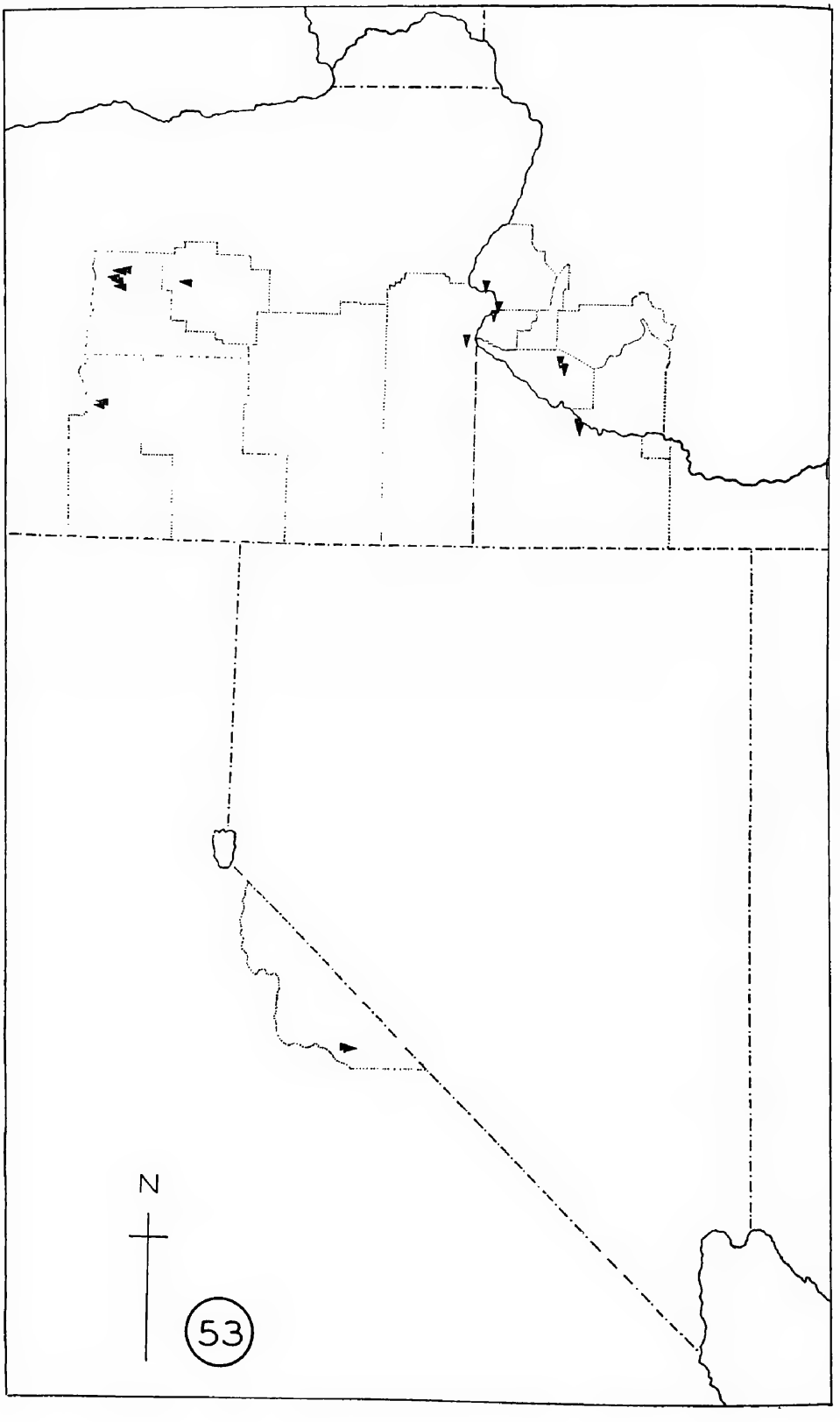
2. Stipules subhomomorphic, all connate, the upper ones only a little less strongly so than the lowest; *banner* 5–5.5 mm., keel 3.3–3.9 mm. long; *stipe* of the pod 0.5–2.5 mm., the body 7–10.5 mm. long; *ovules* 6–11; *leaves* 4–6 cm. long, the terminal leaflet of all leaves jointed; Mono County, California, about 7000 ft. elevation ..... 136. *A. Johannis-Howellii*

1. Pod sessile or subsessile, the stipe up to 0.5 mm. long but commonly less, the body compressed-triquetrous, with narrowly sulcate dorsal face much narrower than the lateral ones; *leaflets* 7–15, the terminal one of all leaves decurrent into the stiff, subspinosely persistent rachis; e. foot of the Cascade Range in Oregon ..... 137. *A. Peckii*

135. Astragalus Mulfordae

Low, slender, commonly sparsely leafy, with a taproot and at length loosely forking, suffruticulose caudex, thinly strigulose with fine, straight, appressed or subappressed hairs up to 0.2–0.5 mm. long, the herbage green or yellowish-green, the leaflets glabrous above; *stems* several or numerous, diffuse and ascending, 1–2.5 dm. long, simple or branched at 1–2 nodes preceding the first peduncle; *stipules* 1.5–5 (6) mm. long, dimorphic, the lowest amplexicaul and connate into a papery-scarious, bidentate sheath, the upper ones semiamplexicaul, free, with triangular or lanceolate, erect or deflexed blades; *leaves* (2.5) 4.5–10.5 cm. long, shortly petioled, with very slender, stiff and commonly subpersistent rachis and (7) 15-25 distant, often scattered, linear-oblong,-oblanceolate, or filiform, obtuse or subacute, mostly folded leaflets 1–11 mm. long, the terminal one of at least some upper leaves continuous with the rachis, rarely all jointed like the lateral ones; *peduncles* (0.5) 1.5–7 cm. long, usually much shorter than the leaf; *racemes* loosely and often remotely (5) 8–19-flowered, the flowers early declined, the axis incurved-ascending, (2) 3–10 cm. long in fruit; *bracts* membranous, ovate or lance-ovate, 0.7–2 mm. long; *pedicels* 0.7–2 mm. long, at anthesis ascending, in fruit arched outward but scarcely elongating; *bracteoles* 0–2; *calyx* 2.8–5 mm. long, strigulose with white, white and fuscous, partly black, or wholly black hairs, the disc 0.5–1 mm. deep, the campanulate tube 1.8–3 mm. long, 1.5–2.4 mm. in diameter, the subulate teeth 0.8–2 mm. long, the whole becoming papery, marcescent unruptured; *petals* white or whitish, drying yellowish, the banner sometimes brownish-striate; *banner* abruptly recurved through (50) 85–100°, ovate- or obovate-cuneate, notched, 6.2–8.2 mm. long, 4.5–5.2 mm. wide; *wings* 6.2–8.1 mm. long, the claws 2.4–2.7 mm., the obliquely obovate-elliptic, obtuse blades 4.2–5.8 mm. long, 2–2.7 mm. wide; *keel* 4.7–5.7 mm. long, the claws 2.3–2.7 mm., the half-circular blades 2.4–3.3 mm. long, 1.8–2.5 mm. wide, incurved through 115–130° to the deltoid, often slightly porrect and then sharply deltoid apex; *anthers* 0.3–0.5 mm. long; *pod* pendulous, stipitate, the stipe 3–5 mm. long, the lunately half-ellipsoid, gently incurved body (9) 10–16 mm. long, 3.2–4.5 mm. in diameter, cuneate at both ends, cuspidate at apex, triquetrously compressed, carinate ventrally by the suture, the lateral angles narrow but obtuse, the lateral faces nearly plane, the dorsal one depressed and openly sulcate, the thin, pale green, finely strigulose valves becoming papery, stramineous, somewhat lustrous, delicately cross-reticulate, inflexed as a complete septum 1.3–2 mm. wide; *ovules* 11–16; *seeds* brown or greenish-brown, smooth but dull, 2–2.6 mm. long.—Collections: 11 (i); representative: *Christ & Ward 6989* (ID, NY); *Jones 6239* (NY, POM, WS); *Ripley & Barneby 6134* (CAS, IDS, NY, RSA); *Maguire & Holmgren 26,227* (NY, UTC).

Sandy bluffs and dunelike talus in the foothills, about 2200–2800 feet, local but forming colonies, along and near the Snake and Boise Rivers and tributary creeks, about the west end of the Snake River Plains, in Ada, Washington, and Owyhee Counties, Idaho, and along the lower Owyhee River in extreme eastern Malheur County, Oregon.—Map No. 53.—May and June.


N
53

ASTRAGALUS MULFORDAE (A. Isabel Mulford, student of *Aloe*, collected in s. Idaho in summer of 1892) Jones, Contrib. West. Bot. 8: 18. 1898.—"Boise City, Idaho, June 7th, 1892, A. Isabel Mulford."—Holotyus, MO! isotypus, NY!—*Onix Mulfordae* (Jones) Rydb. in Bull. Torr. Club 40: 51. 1913.

The elegantly pretty Mulford milk-vetch is easily picked out from among species of the Intermountain States with small, whitish flowers and may be recognized by its combination of lower stipules connate into a scarious sheath with a pod pendulous, stipitate, and almost exactly triquetrous, the three faces being of almost equal width. The pod is sometimes a trifle turgid, and the papery valves become straw-colored and shiny in ripening. Care must be taken, however, to distinguish *A. oniciformis* of the preceding section, a plant very similar in general habit but more densely and loosely pubescent, and with none of the stipules connate. The Mulford milk-vetch is rather local and variable only in a few features. The populations, perhaps but one, found near Boise City have about 15–21 linear-oblanceolate leaflets, of which the terminal one is continuous with the rachis in only a few leaves of some plants; and the flowers are here comparatively large, with calyx about 4.5–5 mm. and banner about 8 mm. long. The commoner form of the species from sandy bluffs along the Snake River and tributary canyons differs slightly in having leaflets mostly 19–25 in number, mostly linear or filiform, the terminal one almost always decurrent in the upper leaves, and flowers on the average a trifle smaller, with calyx about 4–5 mm. and banner 6–8 mm. (but only rarely 8 mm.) long. Whether these recorded differences are significant of racial modification or have been brought out accidentally by faulty sampling from too few colonies of plants remains a problem for future study.

136. ASTRAGALUS JOHANNIS-HOWELLII

Slender, diffuse, with a taproot and at length suffruticulose caudex, thinly strigose-villosulous with subappressed and loosely ascending, nearly straight hairs up to 0.4–0.5 mm. long, the herbage yellowish-green, the leaflets glabrous above; *stems* of the year prostrate or decumbent, 3–20 cm. long, freely branched or spurred toward the base, floriferous upward from below the middle; *stipules* scarious, 1.5–4 mm. long, all amplexicaul and connate, the lowest into a campanulate, subentire or shortly bidentate sheath, the upper ones through about half their length, with erect, triangular free blades; *leaves* 4–6 cm. long, with filiform but wiry petioles and (13) 15–23 distant, mostly scattered, oblong-oblanceolate, -elliptic, or narrowly obovate, obtuse, folded, readily deciduous leaflets, 1.5–6 mm. long, all jointed; *peduncles* ascending, very slender, 8–25 mm. long, shorter than the leaf; *racemes* very loosely 6–12-flowered, the flowers declined in age, the axis somewhat elongating, 1.5–4 cm. long in fruit; *bracts* membranous, triangular-ovate or lanceolate, 0.6–1.5 mm. long; *pedicels* very slender, 0.8–1.3 mm. long, at first ascending, in fruit a little arched outward but scarcely thickened or longer; *bracteoles* 0; *calyx* 2.9–3.8 mm. long, loosely white-strigulose, the subsymmetric disc 0.5 mm. deep, the campanulate tube 1.6–2 mm. long, 1.5–1.7 mm. in diameter, the narrowly subulate teeth 1.3–1.8 mm. long, the whole becoming papery, marcescent unruptured; *petals* whitish, immaculate; *banner* abruptly recurved through about 90°, ovate-cuneate, shallowly notched, 5–5.5 mm. long, 3.6–3.8 mm. wide; *wings* 4.4–5.2 mm. long, the claws 1.4–1.7 mm., the oblong-elliptic, obtuse blades 3.4–3.9 mm. long, 1.4–1.8 mm. wide, the right one nearly erect, the left one strongly incurved from its junction with the claw; *keel* 3.3–3.9 mm. long, the claws 1.5–1.8 mm., the nearly half-circular blades 2.1–2.4 mm. long, 1.4–1.5 mm. wide, incurved through ± 110° to the sharply deltoid, minutely porrect apex; *anthers* 0.4–0.45 mm. long; *pod* pendulous, stipitate, the slender stipe 0.5–2.5 long, the lunately oblong-ellipsoid or half-ellipsoid body 7–10.5 mm. long, 2.5–3 mm. in diameter, cuneately contracted at both ends, minutely cuspidate at apex, triquetrously compressed, carinate ventrally by the suture, the lateral angles narrow but obtuse, the lateral faces nearly flat, the dorsal face

Map No. 53. Nevada and parts of adjoining states. Range of ◆ *A. Mulfordae*; of ♦ *A. Johannis-Howellii*; and of ♦ *A. Peckii.*

deeply and openly sulcate, the thin, pale green, finely strigulose valves becoming papery-membranous, stramineous, delicately cross-reticulate, inflexed as a complete or almost complete septum ± 1 mm. wide; *ovules* 6–11; *seeds* brown or greenish-brown, sometimes faintly purple-dotted, minutely pitted, sublustrous, 1.6–2.4 mm. long.—Collections: 3 (o); representative: *Ferris & Lorraine 10,070* (DS); *Mary DeDecker 908* (NY).

Dry sandy ground among sagebrush, ± 7000 feet, known only from the neighborhood of the type-locality in upper Owens Valley, Mono County, California.—Map No. 53.—July to August.

ASTRAGALUS JOHANNIS-HOWELLII (John Thomas Howell, 1903–) Barneby in Leafl. West. Bot. 8: 124. 1957.—"CALIFORNIA: near Owens River, east of Whitmore Tubs Springs, elevation about 7000 ft., in Long Valley, Mono County, 8 August, 1938, fl. & fr., *John Thomas Howell 14383*."—Holotypus, CAS! isotypus (fragm.), RSA!

The Long Valley milk-vetch, *A. Johannis-Howellii,* may be described as a diminished version of *A. Mulfordae,* differing in the smaller size of nearly all parts, a shorter stipe, and fewer ovules. The species is evidently a rarity; for although native to a region which has been repeatedly and attentively botanized, it is still known only from three collections, possibly from only one population. The species was first identified as *A. lentiformis,* an equally rare astragalus endemic to Sierra and neighboring valleys in the northern Sierra Nevada, but is easily distinguished from this by its stipitate and triquetrous, not sessile and strongly compressed fruit. A third species with tiny, whitish flowers, *A. Lemmoni,* extends south to an isolated station in the upper Owens Valley and ocurs close to *A. Johannis-Howellii,* but in moist ground along streams. It may be recognized by its free stipules, flowers arranged in short, compact racemes on peduncles paired in most axils, and once again by a sessile pod.

137. ASTRAGALUS PECKII

Low, densely leafy, prostrate or closely tufted, with a taproot and suffruticulose caudex commonly beset with stiff, persistent petioles, strigose-pilosulous throughout with fine, loosely ascending and subappressed, straight, incurved, or subsinuous hairs up to 0.3–0.5 mm. long, the herbage cinereous or greenish, the leaflets sometimes medially glabrescent above; *stems* (1) 5–20 cm. long, clustered on the root-crown or radiating from the caudex-branches, commonly branched or spurred in the lower half, simple and floriferous upward; *stipules* submembranous, the lower ones becoming scarious, 1–3 mm. long, all amplexicaul and connate, the lower through about half their length, the upper ones shortly so, with triangular-lanceolate free blades; *leaves* 1–3.5 cm. long, shortly petioled, with (6) 8–14 lanceolate, oblanceolate, or linear-elliptic, acute or subacute, mostly folded, shortly petiolulate lateral leaflets 1–6 mm. long diminishing upward along the stiff, tapering rachis, the terminal leaflet confluent, appearing as a filiform or slightly expanded, sometimes backwardly hooked appendage; *peduncles* strict, (7) 10–20 mm. long; *racemes* loosely 5–9-flowered, the flowers at first ascending, thereafter spreading and declined, the axis (10) 15–20 mm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–1.5 mm. long; *pedicels* slender, straight and (1) 1.3–2 mm. long at anthesis, arched or twisted and (1) 2–2.5 mm. long in fruit, little thickened; *bracteoles* 0; *calyx* 3.3–4.4 mm. long, densely pubescent like the leaves, the disc 0.5 mm. deep, the campanulate, often pinkish tube 1.8–2.1 mm. long, 1.7–2 mm. in diameter, the subulate-setaceous teeth 1.4–2.4 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, the banner veined with dull purple; *banner* abruptly recurved through 90–100°, 5–7.5 mm. long, the cuneate claw expanded into an oval-ovate or suborbicular blade 4–5.2 mm. wide; *wings* 5.7–7.2 mm. long, the claws 2–2.2 mm., the obliquely obovate or oblong-oblanceolate, obtuse or (when broad) subemarginate blades 3.9–5.2 mm. long, 1.7–2.3 mm. wide, both incurved, but the left one more abruptly so, its blade set at about a right angle to the claw; *keel* 4–4.5 mm. long, the claws

2–2.3 mm., the lunately half-circular blades 2.3–2.6 mm. long, 1.5–1.7 mm. wide, incurved through ± 120° to the deltoid apex; *anthers* 0.35–0.45 mm. long; *pod* deflexed, subsessile, sometimes raised on an obscure stipe up to 0.5 mm. long, the body subsymmetrically oblong-ellipsoid, sometimes widest a little above the middle, 5–8 mm. long, 1.9–3 (3.3) mm. in diameter, cuneate or rounded at base, abruptly acute and cuspidate at apex, compressed-triquetrous, with flat lateral faces much broader than the deeply or quite shallowly sulcate dorsal face, the groove either narrow or almost closed, the thin, greenish but densely white-pilosulous valves becoming stramineous, faintly reticulate, inflexed as a complete septum 0.8–1.7 mm. wide; *ovules* 7–9; *seeds* (seldom seen) brown, sparsely punctate, about 1.5 mm. long.—Collections: 8 (i); representative: *Cusick 2818* (MO, NY, ORE, UC, WS); *Peck 19,358* (CAS, ID, NY, RSA), *20,715* (WILLU), *21,931* (CAS, NY, RSA); *Ripley & Barneby 6651* (CAS, NY, K, RSA).

Open flats and gentle slopes, sometimes scattered among sagebrush, in pumice-sand or fine volcanic grit, about 3000–3200 feet, locally plentiful on plains and mesas at the east foot of the Cascade Range in Crook, Deschutes, and northern Klamath Counties, Oregon.—Map No. 53.—June to early August.

ASTRAGALUS PECKII (Morton Eaton Peck, 1871–1959, distinguished Oregon botanist) Piper in Proc. Biol. Soc. Wash. 37: 92. 1924.—"Dry ground, McKenzie Pass, 10 miles northwest of Tumelo (err. "Tumalo"), Crook [actually Deschutes] County, Oregon, *M. E. Peck 9768,* August 3, 1920."—Holotypus, WS! isotypi, G, GH, K, MO, NY, WILLU, WTU!

The Peck milk-vetch is a singular little astragalus, notable for its small, lilac-veined flowers, small, compressed-triquetrous, lentiform pod, and more especially for the thatch of stiff but not truly prickly petioles which forms around the growing bud and persists for one or two years on the caudex-branches. The habit of growth is similar to that of the North American *A. jejunus* and several Asiatic species wholly unlike it in flower and fruit-structure; being the only incipiently tragacanthoid member of the genus in its area of dispersal, it should be identifiable even in the winter months. It is a matter of wonder that Jones (1923, p. 274) could have passed over the earliest collection (*Cusick in 1902,* already cited) as *A. lentiformis,* similar, it is true, in the size and shape of the flowers and fruits but so easily distinguished by its dimorphic stipules, villosulous vesture, and flaccid petioles with terminally jointed leaflet. The latter is known only from a restricted area in northeastern California, whereas *A. Peckii* is apparently confined to the Cascade foothills and immediately adjoining plains toward the headwaters of the Deschutes River. Comparatively common in the vicinity of Bend and Sisters in Deschutes County, the Peck milk-vetch is known to me otherwise only from an unspecified locality in Crook County ("Desert of the Deschutes River") and from a point ten miles south of Chemult in Klamath County, on the Deschutes-Klamath River divide. It has a known range north and south of about one hundred miles.

XXXIV. Sectio ATRATI

Slender perennials, caulescent or subacaulescent, with superficial or aerial root-crown or caudex; *vesture* basifixed; *stipules* free, the lowest ones sometimes fully amplexicaul; *leaves* imparipinnate, with 7–19 leaflets, these sometimes greatly reduced upward, the terminal one jointed or decurrent; *flowers* loosely racemose, horizontal or nodding at full anthesis, small, the banner ± 6.5–13.5 mm. long; *pedicels* persistent or tardily disjointing with the fruit; *calyx-tube* campanulate; *petals* whitish or lilac-tinged, or lurid, the banner recurved through ± 90°, the upwardly dilated wings as long or slightly longer, the keel shortest, its tip rounded or sharply deltoid; *pod* pendulous (from humistrate peduncles variably oriented), subsessile or stipitate, persistent on the receptacle, the body linear-oblong or oblong-elliptic in profile, gently decurved or straight with decurved tip, either dorsiventrally or laterally compressed, the papery or leathery valves inflexed or not; *dehiscence* apical and downward through the ventral suture; *ovules* 10–29.—Spp. 2, xerophytes, of the sagebrush zone within the Great and Columbia

Basins, northeastern Oregon to southwestern Idaho, central Nevada, and southeastern California.

ASTRAGALUS sect. ATRATI Jones, Rev. Astrag. 179. 1923.—Sp. typica: *A. atratus* Wats.—*Tium* sect. *Atrata* (Jones) Rydb. in N. Amer. Fl. 24: 394. 1929.

As first formulated by Jones, the sect. *Atrati* included five species, this number being raised by additions and realignments to eight in Rydberg's equivalent section of *Tium*. It is restricted here to its nucleus of two species, *A. atratus* and the nearly allied *A. salmonis*. Species excluded from the *Atrati* are *A. panamintensis*, differing in its deciduous pod; the somewhat isolated *A. obscurus*, transferred to *Reventi-Arrecti* because of its stiffly erect fruit; *Tium atratiforme* and *A. ibapensis*, which are synonyms respectively of *A. (Miselli) straturensis* and *A. (Genistoidei) diversifolius;* and a pair of *Strigulosi* with connate stipules, *A. Egglestonii* and *A. recurvus*.

The affinities of sect. *Atrati* and of the three small sections immediately following, which seem together to form a loosely united group of highly modified and specialized species, are far from self-evident, but some degree of relationship to the *Miselli* may be assumed. The *Atrati* differ technically from the latter in the downwardly directed curvature of the pod (or at least of its declined beak) and in the poorly or irregularly graduated petals. The prominent, distally dilated wings lend a characteristic aspect to the flower.

Key to the Species of Sect. Atrati

1. Pod linear-oblong or -oblanceolate in profile, 2.5–4.3 mm. in diameter, uni- or semibilocular, the valves either leathery or papery, but unilocular in Idaho and Oregon; *racemes* (4) 5–16-flowered; range of the section ..... 138. *A. atratus*
1. Pod oblong-ellipsoid, 4.5–6.5 mm. in diameter, the leathery valves inflexed as a narrow partial septum; *racemes* 2–8-flowered; e. Oregon and s.-w. Idaho ..... 139. *A. salmonis*

138. ASTRAGALUS ATRATUS

Low, diffuse, often wiry and sparsely leafy, strigulose nearly throughout with straight, appressed and subappressed hairs up to 0.3–0.6 mm. long, the herbage green, cinereous, or canescent, the leaflets equally pubescent on both sides or (more commonly) glabrescent to glabrous above; *stems* numerous, slender, radiating and weakly ascending (often supported by sagebrush), 3–30 cm. long, simple or bearing spurs or branchlets at one or more nodes preceding the first peduncle, together forming loose tufts or mats; *stipules* (1) 1.5–8 mm. long, dimorphic, the lowest ones approximate and often loosely imbricated, mostly ovate or broadly lanceolate and obtuse, papery-scarious, conspicuously adnate to the petiole-base, decurrent around half to the whole stem's circumference, the median and upper ones narrower and shorter, with triangular-lanceolate, subherbaceous blades; *leaves* (1.5) 3–14.5 cm. long, with slender petiole and 7–15 distant or remote, narrowly oblong, or in some lower leaves oval-oblong, or in all leaves of some plants linear-elliptic or setaceous, obtuse, subacute, or (when broad) emarginate, commonly folded or involute leaflets 1.5–17 mm. long; *peduncles* weakly incurved-ascending, slender or filiform, (1.5) 3.5–16.5 cm. long, a little shorter to much longer than the leaf; *racemes* loosely or remotely (4) 5–16-flowered, the flowers nodding, the axis elongating, (1.5) 3–17 cm. long in fruit; *bracts* membranous, ovate or lanceolate, (0.8) 1–2.5 mm. long; *pedicels* very slender or filiform, (1.5) 2–4.7 mm. long at anthesis, in fruit straight and ascending at a wide angle or spreading, or ± contorted, or abruptly refracted, 2.5–6.5 mm. long; *bracteoles* 0, if present minute; *calyx* 3–7.6 mm. long, strigulose with black, white, or mixed black and white hairs, the subsymmetric disc (0.5) 0.7–1.1 (1.5) mm. deep, the campanulate tube 2.3–4.6 mm. long, 1.7–3.6 (3.8) mm. in diameter, the subulate teeth 0.7–2.2 mm. long; *petals* whitish or pale lilac; *banner* 6.3–13.4 mm. long, the shortly cuneate claw expanded into an oblong or ovate-oblong, deeply retuse blade 4–8.6 mm. wide, this pinched in at the middle in the form of two pocket-like folds and thus often appearing fiddle-shaped; *wings*

(0.6–2 mm. longer) 7.4–14.4 mm. long, the claws 2.8–5.7 mm., the obliquely oblong-oblanceolate, obliquely obovate, or half-obovate blades 5.2–9.8 mm. long, gradually but strongly incurved into the rounded and erose, emarginate, or ± deeply 2-dentate or -lobed apex; *keel* 5.9–10 mm. long, the claws 2.9–5.6 mm., the obliquely half-obovate or triangular blades 3.5–5.2 mm. long, 2–3.2 mm. wide, abruptly incurved through 95–120° to the rather sharply deltoid, sometimes obscurely porrect apex; *anthers* 0.4–0.65 (0.8) mm. long; *pod* loosely pendulous, stipitate or subsessile, the stipe when present concealed by the marcescent calyx but up to 2 mm. long, the body linear-oblong, linear-oblanceolate, or narrowly elliptic in profile, (1) 1.2–2.2 cm. long, (2.3) 2.5–4.3 mm. in diameter, tapering at base into the stipe, ± abruptly cuneate at apex, gently decurved, or straight but the thick, salient ventral suture even then more convex than the dorsal one and the tip declined, variably compressed, uni- or bilocular, the slightly or scarcely fleshy, green, purplish, or mottled valves becoming leathery or papery, faintly reticulate, strigulose; *ovules* 10–29; *seeds* (little known) black, pitted or rugulose, ± 2–2.5 mm. long.

The picture of racial modification in *A. atratus* is complex, but its main outlines are clear enough. The species has differentiated dichotomously into northern and southern branches divergent from the physical barrier of the Snake-Humboldt water parting in northeastern Nevada, the populations found on this line and northward having subentire wing-petals and unilocular pods; to the south the wings are deeply toothed or lobed at apex and the pod is bilocular or nearly so. Within each area the leaflets vary from linear-filiform to oblong, leaflets of a narrow type being usually associated with an elongate, very slender raceme-axis, filiform pedicels, and a generally attenuated habit of growth. Furthermore, the smallest flowers commonly coincide with linear leaflets, but the correlation of these features is imperfect. The leaflet-variants of var. *atratus* in Nevada have been described as varietally distinct, but the extreme states are rare and intermediates much commoner. The *stenophyllus* form becomes predominant on the headwaters of the Humboldt where it approaches the range of var. *owyheensis*. Populations in this area of transition provide examples of a bilocular pod combined with the growth-habit of var. *owyheensis* and of an unilocular pod combined with jointed terminal leaflets, thereby confirming Jones's evaluation of *A. owyheensis* as a geographic variant of *A. atratus*. In the northern area the leaflet-forms are more sharply differentiated, and it seems proper to separate var. *inseptus*, a relatively coarse and leafy plant with jointed terminal leaflets and leathery pods, from the extremely delicate var. *owyheensis* with decurrent terminal leaflets and pods of papery texture.

The var. *mensanus* is isolated from the rest of its species in the northern Mohave Desert and is distinguished by a laterally compressed pod devoid of dorsal groove. It may possibly deserve the rank of species, but scarcely differs from var. *atratus* except in this one respect.

Key to the Varieties of A. atratus

1. Pod (subsessile or shortly stipitate, uni- or bilocular) ± dorsiventrally compressed, openly grooved or excavated dorsally, the dorsal suture depressed and lying in the groove; centr. Nevada to e. Oregon and s.-w. Idaho (2)
   2. Wing-petals deeply cleft at apex into 2 divaricate lobes 1–2.5 mm. long; *pod* subbilocular, the septum at least 0.6 mm. wide, the valves leathery. Leaflets variable in shape, but the terminal one jointed to the rachis; Nevada ..... 138a. var. *atratus*
   2. Wing-petals rounded and only erose or shallowly notched at apex; *pod* unilocular or essentially so, the septum 0 or vestigial, not over 0.2 mm. wide; Idaho, Oregon, and extreme n.-e. Nevada (3)
      3. Leaflets all very small, narrow, and remote, the terminal one continuous with the rachis or represented by a slight dilation of the rachis-tip; *pod* papery; e. Oregon, extreme s.-w. Idaho (Washington to Owyhee County) and n.-e. Nevada ..... 138d. var. *owyheensis*
      3. Leaflets more ample and less scattered, the terminal one jointed to the rachis; *pod* of leathery texture; n. side of Snake River Plains in Camas County, Idaho ..... 138c. var. *inseptus*
1. Pod (sessile or nearly so, bilocular) laterally compressed, 2-sided, the sutures both salient; local in Inyo County, California ..... 138b. var. *mensanus*

138a. ASTRAGALUS ATRATUS var. ATRATUS

Variable in stature, the stems 3–17 (25) cm. long; *herbage* commonly cinereous or canescent, sometimes greenish, the leaflets either glabrous or pubescent above; *stipules* 1.5–4 mm. long; *leaves* (1.5) 3–11.5 (14.5) cm. long, with (7) 9–13 (15) mostly narrowly oblong, in some plants all or nearly all linear-setaceous, or in some lower leaves oval-oblong, obtuse or subacute leaflets 2.5–14 (17) mm. long; *peduncles* (3.5) 5–16.5 cm. long; *racemes* (4) 6–15-flowered, the axis (1.5) 3–14 cm. long in fruit; *calyx* (4.9) 5.2–7.2 mm. long, the tube (3.4) 3.6–4.6 mm. long, 2–2.9 mm. in diameter, the teeth 1.3–2 (2.6) mm. long; *petals* whitish, veined or suffused with dull lavender; *banner* (8) 9–12.2 mm. long, 4.2–6 mm. wide; *wings* 1–2 mm. longer, 9.2–13.4 mm. long, the claws (3.4) 4.1–4.5 mm., the obliquely oblong-oblanceolate blades 6.5–9.8 mm. long, gently incurved and expanded upward, 1.5–3.2 mm. wide just below the apex, where cleft into 2 unequal, erose, irregularly twisted, usually divaricate lobes (1) 1.5–2.4 mm. long; *keel* 6.3–8.3 (9.5) mm. long, the claws (3) 3.6–4.5 (5) mm., the blades 3.6–5 mm. long, (2.1) 2.4–2.8 mm. wide; *pod* stipitate, the stipe 0.5–2 mm. long, the linear-oblong or -oblanceolate body (1) 1.5–2.2 cm. long, (2.3) 2.5–3.5 (4) mm. in diameter, gently decurved or, if nearly straight, the thick, prominent ventral suture slightly more convex than the dorsal one, the leathery valves inflexed as a complete or nearly complete septum 0.6–1.3 mm. wide; *ovules* 17–24.—Collections: 22 (x); representative: *Maguire & Holmgren 25,373* (NY, RSA, UTC), *25,784* (NY, RSA, UTC); *Ripley & Barneby 3668, 5558* (CAS, RSA), *6190, 9317* (RSA).

Gravelly clay ridges and hillsides in stiff dry soils derived from basalt or granite, the plants usually scattered among sagebrush and taking shelter under or entangled in it, 4900–9500 feet, widespread and locally plentiful on the higher plains and foothills of central and northern Nevada within the valleys of the Humboldt and Reese Rivers (Elko to Pershing, south to Churchill and northern Nye County); somewhat isolated, on limestone, in the White Pine Mountains, White Pine County.—Map No. 55.—Late May to July.

ASTRAGALUS ATRATUS (clothed in black, of the inflorescence) Wats., Bot. King 69, Pl. XI. 1871.—"Found on the Pah-Ute, Havallah, and Toyabe ranges, Nevada; 6–7000 feet altitude . . . (265)."—Cotypi, collected in 1868 in the Pah-Ute (flor., June) and Toyabe (fruct., July) mountains, US! isotypi, GH, NY! *Watson 265* from the Havallah Mts. at GH, US = *A. obscurus—Tragacantha atrata* (Wats.) O. Kze., Rev. Gen. 943. 1891. *Hamosa atrata* (Wats.) Rydb. in Bull. Torr. Club 34: 48. 1907. *Tium atratum* (Wats.) Rydb. in N. Amer. Fl. 24: 394. 1929.

Astragalus atratus var. *stenophyllus* (narrow-leaved) Jones in Zoë 3: 297. 1893.—"This is No. 3840 of my sets of 1882. Collected June 14, 1882, at Palisade, Nevada."—Holotypus, *Jones 3841* (!), POM (2 sheets)! isotypi, CAS, NY, P, US!—*A. atratus* var. *arctus* (narrow) Shield. in Minn. Bot. Stud. 1: 160. 1894, a superfluous substitute.

Astragalus atratus var. *phyllophorus* (leafy, of the relatively broad leaflets) Jones, Contrib. West. Bot. 10: 62. 1902.—"Nevada."—Lectotypus, collected by Jones at Austin, Nevada, June 16, 1882, POM (3 sheets)! isotypi, GH, NY!

The mourning milk-vetch, var. *atratus*, is a modest, almost weedy plant. It may be found in the form of loosely woven mats in open places among junipers and piñons, but more often it retires into the shade and shelter of sagebrush through which the stems weakly clamber, concealed from ready view. The petals are dirty white with no hint of cream or yellow and are commonly veined or suffused with lilac. Observed by day they have a peculiarly soiled, pinched look, as though wilting after frost; but seen shortly after sunset in the fading light, they expand into firm and healthy condition. It may be that they are nocturnally pollinated. On close examination the form of the fiddle-shaped banner, deeply pouched on either side of the fold, and the elongate wings with their erose, twisted lobes, are seen to be unlike those of any other astragalus.

138b. Astragalus atratus var. mensanus

Wholly similar in habit to var. *atratus,* the herbage greenish-cinereous, the leaflets either glabrous above or equally pubescent on both sides; *stems* commonly taller 1–2.4 (3) dm. long; *stipules* 2.5–5 mm. long; *leaves* (3.5) 5–13.5 cm. long, with (7) 9–15 oblong-oblanceolate or -elliptic (or in some lower leaves shorter and oval), obtuse or retuse, flat or loosely folded leaflets 3–16 mm. long, all jointed; *peduncles* (3) 4.5–13 cm. long; *racemes* (5) 7–18-flowered, the axis (3) 4–10.5 cm. long in fruit; *calyx* 5–7.6 mm. long, the deep disc 1.1–1.5 mm., the tube 4.5–5.6 mm. long, 2.9–3.6 (3.8) mm. in diameter, the teeth 0.8–2.6 mm. long; *petals* broadly margined or tipped with lilac-purple, paler proximally; *banner* 9.8–13.4 mm. long, 7.4–8.6 mm. wide; *wings* 0.5–1.5 mm. longer, 11.2–14.4 mm. long, the claws 4.3–5.7 mm., the blades 7.7–9.6 mm. long, 2.8–3.2 mm. wide; *keel* 8.2–10 mm. long, the claws 4.3–5.6 mm., the blades 4.2–5.2 mm. long, 2.8–3.2 mm. wide; *anthers* large for the species, 0.6–0.8 mm. long; *pod* sessile or nearly so, the obscure stipe, if present, not over 0.7 mm. long, usually obsolete, the body 1.6–2.2 cm. long, 3.5–4.3 mm. in diameter, the septum broad or complete, 1–2.7 mm., wide; *ovules* (18) 23–29.—Collections: 5 (i); representative: *Hall & Chandler 7154* (POM, UC); *Barneby 11,338* (CAS, NY, RSA).

Open flats and hillsides, in volcanic clay and gravel, with piñons, commonly taking shelter under and entangled in low sagebrush or *Salvia Dorii* (Kell.), Abrams, 5400–6050 feet, rare and local in the desert mountains bordering Panamint Valley to the north and west, Inyo County, California.—Map No. 55.—Late April to June.

Astragalus atratus var. mensanus (of Darwin Mesa) Jones in Proc. Calif. Acad. Sci. II, 5: 665. 1895.—"No. 792, Coville and Funston. Along the Darwin road about two miles [3 km.] southward from Mill Canyon Divide, Darwin Mesa, Inyo County, California, May 20, 1891."—Holotypus, US! isotypus (fragm.), NY!—*Tium mensanum* (Jones) Rydb. in N. Amer. Fl. 24: 395. 1929 (*"mensarum"*). *A. mensanus* (Jones) Abrams, Ill. Fl. Pac. St. 2: 591, fig. 2856. 1944 (*"mensarus"*).

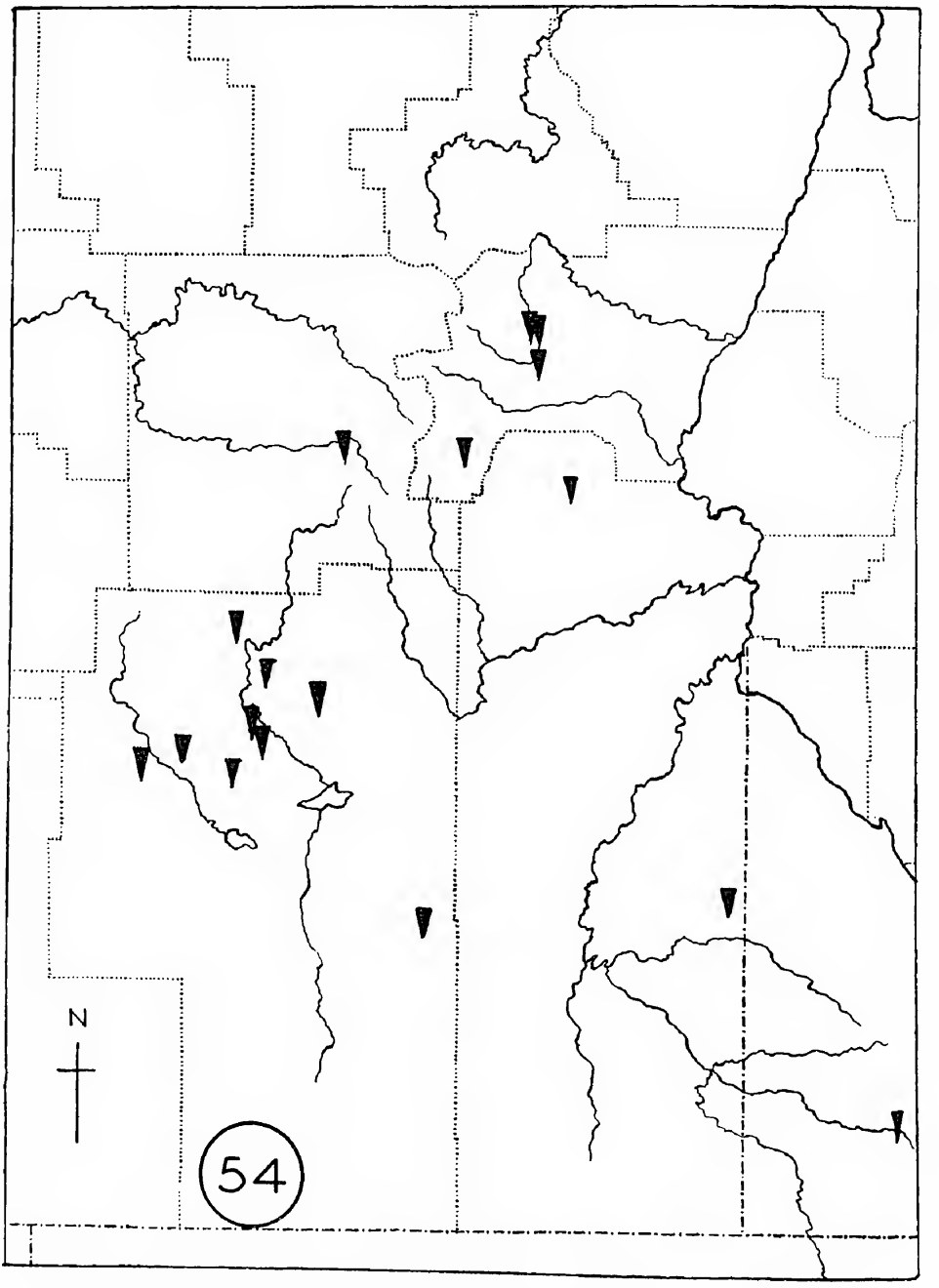
The Darwin milk-vetch, var. *mensanus,* agrees closely with var. *atratus* in growth-habit, in pubescence, in the modified wing-petals, and in ecology; it would be impossible to distinguish specimens lacking fruit or data of locality. The stems are usually a little taller, the leaflets a trifle more ample, and the flowers, on the average, a little larger and more deeply suffused with lilac; but these are tendencies and not absolute differences. The status of var. *mensanus* depends on the importance attached to the modified compression of the fruit, a matter of individual judgment.

The map accompanying the Death Valley Report does not show the precise whereabouts of Mill Canyon or Darwin Mesa, but it is clear from Coville's detailed itinerary that the type station of the Darwin milk-vetch was close to Darwin itself, probably on a southerly spur of what is now called the Nelson Range. My collection, an approximate topotypus, came from near the divide between Panamint and Saline Valleys in the Nelson Range, where var. *mensanus* was gathered also by Hall and Chandler. In this place it is associated, as Coville found it, with *A. inyoensis.* The two other known gatherings were made on the same day in 1930 by Ralph Hoffmann and E. C. Jaeger at a point nineteen miles southwest of Darwin, presumably on the east slope of the Argus Range. The established range of var. *mensanus* extends about thirty-five miles north and south; but it seems possible that all the material is derived, broadly speaking, from two highly localized populations.

138c. Astragalus atratus var. inseptus

Wholly similar to var. *atratus,* the herbage greenish, the leaflets glabrous above; *stipules* 1.5–8 mm. long; *leaflets* 9–15, narrowly oblong-oblanceolate to linear-oblong or (in some lower leaves) oval, obtuse or notched, 3–13 mm. long, all jointed; *calyx* 4.7–6.4 mm. long, the tube 3.3–4.2 mm. long, 2.2–3.1 mm. in diameter, the teeth 1.5–2.2 mm. long; *petals* whitish, the banner and keel-tip faintly lilac-tinged; *banner* 8–11.3 mm. long, 5.8–7.2 mm. wide; *wings* 0.6–1.8 mm.

longer, 9.6–12 mm. long, the claws 3.4–5.1 mm., the obliquely obovate or half-obovate blades 6.2–7.5 mm. long, 3–4.5 mm. wide, erose-emarginate or very shallowly notched at apex; *keel* 7.2–9.1 mm. long, the claws 3.4–5 mm., the blades 4–4.8 mm. long, 2.4–2.9 mm. wide; *pod* subsessile or very shortly stipitate, the stipe 0.3–1.1 mm. long, the body 1.2–1.8 cm. long, 3–4.2 mm. in diameter, in outline and texture like that of var. *atratus* but the septum obsolete; *ovules* (14) 16–21.—Collections: typus only.



Map No. 54. Parts of eastern Oregon and adjoining Idaho. Range of *A. salmonis.*

Stony flats, in stiff soil moist in spring, ± 5000 feet, known only from the type-locality in the foothills at the northern edge of the Snake River Plains in Camas County, Idaho.—Map No. 55.—May and June.

ASTRAGALUS ATRATUS var. INSEPTUS (lacking septum) Barneby ap. Hitchc. & al. in Univ. Wash. Pub. Biol. 17: 220. 1961.—"*Ripley & Barneby 10673*, Camas Prairie, 10 miles s.e. of Fairfield, Camas Co., Ida., June 10, 1951.—Holotypus, CAS! isotypi, IDS, K, POM, RM, RSA, US, WS, WTU!

The plants described as var. *inseptus* closely resemble the more leafy states of var. *atratus*, differing in the almost entire wing-petals and strictly unilocular pod. In the last respect they are like var. *owyheensis*, but the coarser growth-habit, well-developed leaflets all jointed to the rachis, and stiff-walled pod are characteristic.

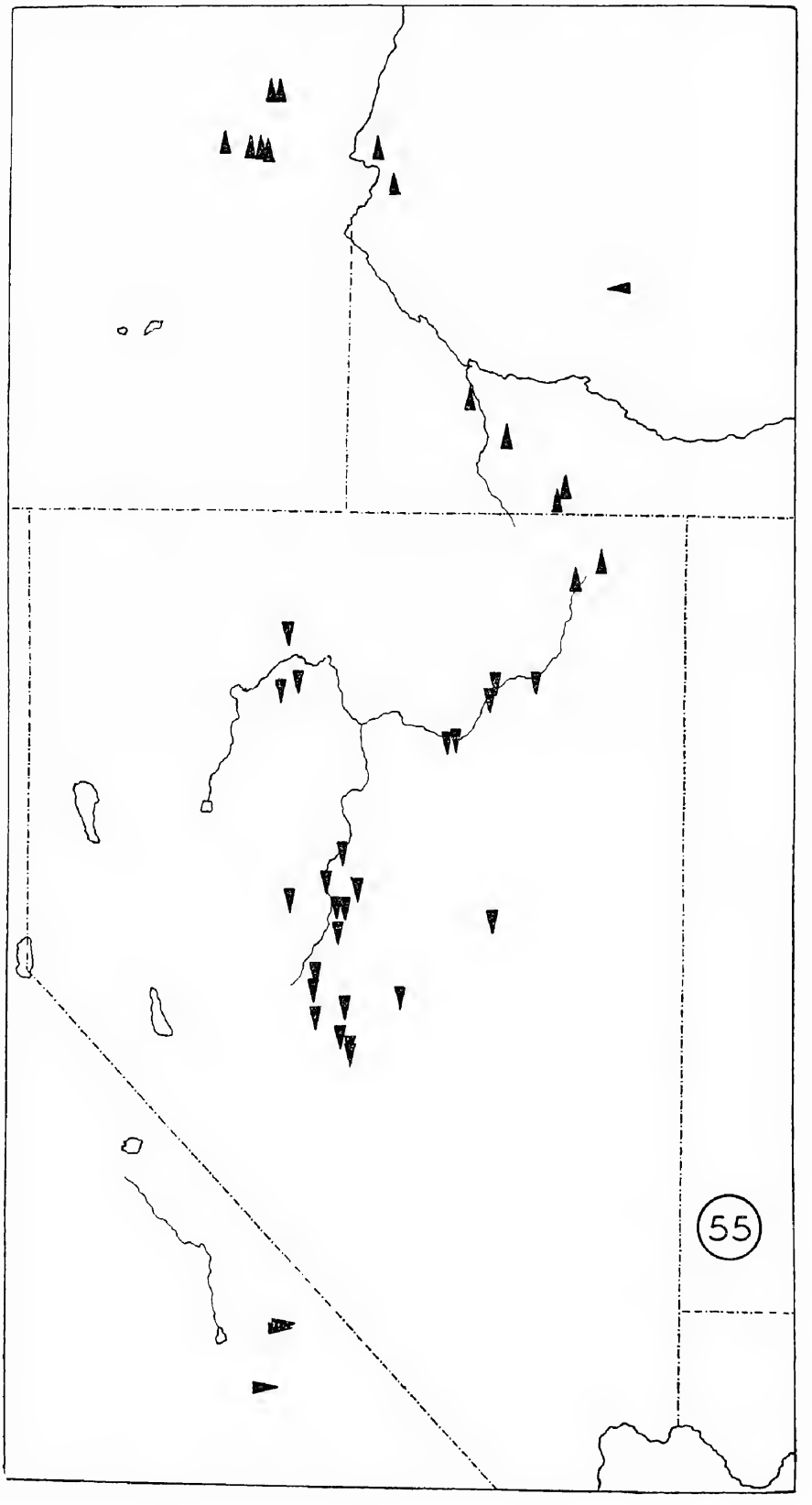
138d. ASTRAGALUS ATRATUS var. OWYHEENSIS

Essentially like var. *atratus* but extremely slender and delicate in all its parts, the herbage greenish-cinereous, the leaflets glabrous or nearly so above; *stems* mostly short, 1–15 (20) cm. long, numerous and closely tufted, greatly surpassed by the inflorescences; *stipules* 1–3.5 mm. long; *leaves* (2) 4–14 cm. long, with 7–11 (13) remote, often scattered, linear-elliptic, involute or conduplicate leaflets 1.5–7 (10) mm. long, those of the upper leaves reduced in size, the terminal one continuous with the very slender or filiform rachis; *peduncles* subfiliform, (1.5) 3.5–12.5 cm. long; *racemes* remotely (3) 5–12-flowered, the axis (2) 5–17 cm. long in fruit; *calyx* 3–5.8 mm. long, the tube 2.3–4 mm. long, 1.7–2.7 mm. in diameter, the teeth 0.7–2.1 mm. long; *petals* whitish, faintly lavender-tinged; *banner* 6.3–9.9 mm. long, 4–6.4 mm. wide; *wings* 0.8–1.9 mm. longer, 7.4–10.5 mm. long, the claws 2.8–4 mm., the obliquely obovate or half-obovate blades 5.2–7.2 mm. long, 2.2–3.6 mm. wide just below the rounded, erose, or shallowly emarginate apex; *keel* 5.9–7.7 mm. long, the claws 2.9–4 mm., the blades 3.5–4.2 mm. long, 1.9–2.4 mm. wide; *pod* stipitate, the stipe 1–2 mm. long, the body narrowly elliptic-oblanceolate in profile, 1.4–2 cm. long, 3–4 mm. in diameter, the thinly paper valves not inflexed; *ovules* 10–17.—Collections: 19 (ii); representative: *Peck 26,069* (CAS, RSA), *25,427* (WILLU); *Cronquist 7822* (NY, RM, RSA); *Jones 6242* (NY, POM); *Ripley & Barneby 6578* (CAS, NY, RSA).

Dry hillsides and gravelly flats, on basalt, usually taking shelter under and entangled in low sagebrush, 3500–6000 feet, local but plentiful in scattered stations, from the headwaters of the Powder and Burnt Rivers in Baker and northern Malheur Counties, Oregon, to adjoining Washington County, Idaho; also along the Bruneau River in Owyhee County, Idaho, south and east to southern Twin Falls County and the headwaters of the Humboldt River in northern Elko County, Nevada.—Map No. 54.—May to July.

ASTRAGALUS ATRATUS var. OWYHEENSIS (Nels. & Macbr.) Jones, Rev. Astrag. 182. 1923, based on *A. owyheensis* (of Owyhee [a corruption of Hawaii] County, Idaho) Nels. & Macbr. in Bot. Gaz. 55: 375. 1913.—"No. 1887, collected July 2, 1912, above the 'Hot Hole' of the East Bruneau, Owyhee Co., Idaho, is the type."—Holotypus, RM! isotypi, GH, ID, MO, NY, POM, US!—*Tium owyheense* (Nels. & Macbr.) Rydb. in N. Amer. Fl. 24: 395. 1929.

The Owyhee milk-vetch is one of the most delicately fashioned of all astragali. Its many very slender stems, its threadlike peduncles and petioles (the latter beset with tiny, scattered leaflets), and its airy, remotely flowered racemes of small, whitish flowers succeeded by narrowly ellipsoid pods pendulous from capillary pedicels all contribute to a characteristic elegance of habit. It has been mentioned above that around the sources of the Humboldt River in Elko County, Nevada, there occur forms of var. *atratus* nearly as slender, and in this area the two varieties can be told apart only by examining the shape of the wing-tips or the development of septum in the pod. According to Jones (1923, l.c.) the plants of var. *owyheensis* can become three feet in diameter in grassy meadows; in the more usual habitat of stony flats and dry hillsides among sagebrush, the loosely woven mats or semiprostrate tufts are rarely half as large. The peduncles and racemes together are commonly longer than the proper stems.


55

139. Astragalus salmonis

Low, tufted, shortly caulescent or subacaulescent, thinly strigulose with fine, straight, appressed or subappressed hairs up to 0.3–0.45 mm. long, the herbage greenish or subcinereous in youth, the leaflets glabrous or nearly so above; *stems* several or numerous, tufted on the divisions of a shortly forking caudex, 1–5 cm. long, the internodes mostly contracted and mostly shorter than the loosely imbricated stipules, or 1–4 of them developed and up to 2 cm. long; *stipules* submembranous, 2–4.5 mm. long, mostly ovate, obtuse, strongly adnate to the petiole-base and amplexicaul-decurrent around the whole stem's circumference or nearly so, the upper ones broadly lanceolate, sometimes subacute; *leaves* mostly subradical, 2.5–10 cm. long, all petioled, with (9) 11–15 (19) distant, narrowly oblong-elliptic, linear-oblong, or sometimes (especially in some lower leaves) oblong-obovate, obtuse or subacute, flat or loosely folded leaflets (1) 2–8 mm. long, all jointed; *peduncles* appearing scapose or nearly so, 3–12 cm. long, at anthesis incurved-ascending, reclinate and commonly longer than the leaves in fruit; *racemes* loosely 2–8-flowered, the flowers horizontal or nodding, the axis somewhat elongating, (0.5) 1–8 cm. long in fruit; *bracts* membranous, ovate or ovate-acuminate, 1–1.5 (2) mm. long; *pedicels* at anthesis 1–1.8 mm. long, in fruit irregularly spreading or contorted, 1.5–4 mm. long; *bracteoles* 0; *calyx* 5–8.9 mm. long, densely strigulose with black or mixed black and white hairs, the disc 0.6–1.2 mm. deep, the campanulate, often purplish tube 3.6–6 mm. long, 2.6–4 mm. in diameter, somewhat basally dilated behind the pedicel, the broadly subulate teeth 1.4–2.9 mm. long, the dorsal one sometimes shortest, the whole becoming papery, marcescent, usually ruptured; *petals* dull whitish, tinged or suffused with lavender, the keel-tip dull purple; *banner* 9.5–13.2 mm. long, the cuneate claw gradually expanded into an obovate or ovate, retuse blade 7–9 mm. wide; *wings* (as long or a trifle longer) 9.7–13.2 mm. long, the claws 3.7–5 mm., the obliquely oblanceolate or triangular-obovate blades 6.6–9.6 mm. long, distally incurved into the erose-emarginate or obscurely notched apex; *keel* 7.3–10.2 mm. long, the claws 3.7–5 mm., the half-obovate blades 4.2–5.9 mm. long, 2.4–3.1 mm. wide, abruptly incurved through 90–100° to the bluntly deltoid apex; *anthers* (0.4) 0.5–0.75 mm. long; *pod* essentially pendulous but often humistrate and consequently falling at random angles to the axis, stipitate, the stipe 1.5–3.5 mm. long, concealed by the persisting calyx, the obliquely oblong-ellipsoid body (1.3) 1.5–2.2 cm. long, 4.5–6.5 mm. in diameter, cuneate at both ends or tapering proximally into the stipe, cuspidate at apex, gently decurved, subtrigonously compressed, keeled ventrally by the thick, salient, convexly arched suture, flattened or openly grooved dorsally (thus inversely boat-shaped), the lateral angles convex, the somewhat fleshy, finely but densely strigulose, brightly red-mottled valves becoming leathery and rugulose-reticulate, inflexed (sometimes only through the lower half of the pod) as a narrow, incomplete septum 0.7 mm. wide or less; *ovules* (14) 17–29; *seeds* black, pitted and rugulose, 2.6–3.1 mm. long.—Collections: 27 (i); representative: *Cusick 1850* (ND, WS), *2365a* (ORE, POM, WS); *Peck 20,567* (WILLU), *21,588* (NY, WILLU), *26,044* (RSA, WILLU); *Leiberg 2033* (NY, POM, UC); *Ripley & Barneby 9481* (CAS, RSA).

Dry stony slopes and hillsides, in stiff clay soils overlying basalt, often sheltering under sagebrush, ± 3500–4600 feet, local, eastcentral Oregon, on the upper John Day, Burnt, and Silvies Rivers, perhaps north to the head of the Grande Ronde, in Baker, northern Harney, and Malheur Counties, reported from Union

Map No. 55. Nevada and parts of adjoining states. Range of *A. atratus*: ◆ var. *atratus*; ◗ var. *mensanus*; ◖ var. *inseptus*; and ◢ var. *owyheensis*.

County; and in Owyhee County (northwest of Riddle; Triangle), southwestern Idaho.—Map No. 54.—Late April to June.

ASTRAGALUS SALMONIS (of *Salmo*, the genus of trout, in allusion to the type-station) Jones, Contrib. West. Bot. 8: 9. 1898.—"Trout Creek, Blue Mts. Oregon, May 25th, 1885, Howell. Union Co. Oregon, May to June, Cusick. Also by Leiberg in the same situations in 1896. First collected by Barthoff [= Dr. J. H. Bartholf, MO!] at Harney, Oregon, April to May, 1875." —Lectotypus, *Howell (No. 377)*, GH! isotypi, G, K, NY (2 sheets), ORE, P, WS, WTU! paratypi, *Cusick 38*, GH!, *Leiberg 2033*, cited supra!—*Tium salmonis* (Jones) Rydb. in N. Amer. Fl. 24: 396. 1929.

The Trout Creek milk-vetch, beautifully illustrated by Abrams (1944, fig. 2858), might be described as a dwarfed, rather large-flowered version of *A. atratus*. The wing-petals are similar in shape in both species, that is oblanceolate, incurved beyond the keel-tip, and often slightly longer than the banner; but in *A. salmonis* they lack the divergent apical lobes characteristic of typical var. *atratus*, being merely notched or erose-emarginate as in *A. atratus* var. *owyheensis*. In eastern Oregon and in Owyhee County, Idaho, *A. salmonis* and var. *owyheensis* are sympatric and near Baker City have been found intimately associated on the same hillside. Here no one ignorant of var. *atratus* would suspect that two astragali differing so greatly in habit of growth could be such near kindred. However the Trout Creek milk-vetch is distinguished from all forms of the polymorphic *A. atratus* principally by its broader, inversely boat-shaped pod.

Trout Creek, the type-locality, is given by Abrams as situated in Grant County; but according to the label in the Howell herbarium (ORE) it is the same as Silvers Valley, probably the valley of Silver Creek in northwestern Harney County. I have seen no Cusick material actually labeled Union County, and this may have been assumed by Jones. Cusick might have encountered the species near Baker City, but it is nevertheless to be sought at the head of the Grande Ronde River.

XXXV. Sectio QUINQUEFLORI

Very slender, diffuse, inconspicuous, caulescent herbs, potentially perennial but flowering precociously (sometimes before the cotyledons have withered) and then appearing annual; *vesture* basifixed; *stipules* free (the lowest sometimes very obscurely united); *leaves* imparipinnate with 5–15 very narrow distant leaflets; *peduncles* filiform, dimorphic, the early ones subradical, short, often 1-flowered, the later ones elongate, surpassing the leaf, loosely or remotely 2–7-flowered, the minute flowers declined in age, the banner 4–7 mm. long; *pedicels* very slender, little thickened, tardily disjointing with the fruit; *calyx-tube* campanulate; *petals* whitish, lavender-tinged, regularly graduated, the keel-tip strongly incurved, obtuse; *pod* pendulous or (when humistrate) adventitiously ascending, sessile or nearly so, persistent or very tardily deciduous, small, ovoid- or oblong-ellipsoid, straight or a little decurved, with prominent ventral suture more strongly arched than the dorsal, flattened or shallowly sulcate dorsally, subbi- or subunilocular, the valves papery; *dehiscence* apical and downward through the ventral suture; *ovules* 8–18.—Spp. 2, xerophytes, of southwestern United States and northcentral Mexico.

ASTRAGALUS sect. QUINQUEFLORI, sect. nov., notulis multis cum *Atratis* congruentes, sed pedunculis dimorphis (praecocioribus subradicalibus 1-floris, caeteris elongatis plurifloris), floribus minimis, adspectu proprio insignes; a *Strigulosis* parvifloris stipulis inter se liberis ulterius dissimiles.—Sp. typica: *A. quinqueflorus* Wats.

The two species of sect. *Quinqueflori* have been unnaturally separated in revisions of the genus so far published. Jones (1923, p. 84) placed *A. quinqueflorus* at the end of his sect. *Homalobi*, although he noted its habital similarity to *A. Brandegei*, which he associated (1923, p. 187) with *A. cobrensis* and *A. Rusbyi* in sect. *Strigulosi*. Rydberg (1929, p. 361) transferred *A. quinqueflorus* to *Phaca* sect. *Microcystes*, and (1928, p. 129; 1929, p. 373) aligned *A. Brandegei* next to *A. eucosmus* in *Atelophragma*, a most unnatural arrangement based on a fortuitous resemblance in the fruits alone. Apparently neither Jones nor Rydberg observed the narrow partition in the pod of *A. quinqueflorus*, which would have required its removal from *Phaca* or from sect. *Homalobi* to *Atelophragma* or an equivalent group. It is true that the pods

of both species resemble that of some *Strigulosi*, especially *A. cobrensis;* but the superficial root-crown, free stipules, and especially the peculiar dimorphic peduncles and idiosyncratic growth-habit entitle them to a separate section. The *Quinqueflori* recall the *Atrati* in many technical characters, but differ in growth-habit, tiny flowers, and ecology.

Key to the Species of Sect. Quinqueflori

1. Pod 1–1.8 cm. long, subbilocular, the septum broad, often nearly complete, 1.4–2 mm. wide; *ovules* 14–18; s. Rocky Mountains in Colorado, to centr. and s.-w. New Mexico, w.-centr. Arizona, and centr. Utah ..... 140. *A. Brandegei*
1. Pod 0.6–1 (1.1) cm. long, subunilocular, the septum very narrow or rudimentary, not over 0.5 m. wide; *ovules* 8–14; Chihuahua to Zacatecas ..... 141. *A. quinqueflorus*

140. Astragalus Brandegei

Low, very slender, often flowering the first season, sometimes as precocious seedling plants before the cotyledons have withered, but potentially perennial, with an ultimately woody taproot and shortly forking suffruticulose caudex, strigulose with appressed or narrowly ascending hairs up to 0.4–0.7 mm. long, the herbage cinereous or greenish-cinereous, the leaflets glabrous above; *stems* slender but wiry, mostly 1–10 cm., more rarely up to 4 dm. long, simple or commonly bearing short branches or spurs in the lower axils, when short then loosely tufted, and the leaves appearing subbasal due to shortening of all or most internodes, when longer then diffuse or prostrate, with internodes up to 3.5 cm. long; *stipules* 1.5–4 (5) mm. long, the lowest deltoid, early becoming papery, fully amplexicaul and the contrapetiolar margins free or if shortly connate then only obscurely so (and less connate than adnate to the petiole-base), the upper ones progressively narrower, the uppermost lanceolate, herbaceous, free; *leaves* (1) 2–9 (15) cm. long, with slender petioles and 5–15 distant, linear-filiform, linear-oblong, or very narrowly elliptic, obtuse or subacute, involute or conduplicate, exceptionally flat leaflets (4) 6–23 mm. long, the terminal one longest; *peduncles* dimorphic, the early ones much shorter than the leaves, often subradical and commonly only 1-flowered, the later ones elongate, filiform, surpassing the leaves and up to 13 (17) cm. long, reclinate in fruit; *racemes* 1–5 (7)-flowered, the remote or distant flowers ascending in early anthesis, later declined, the axis (0) 0.5–5 (8) cm. long in fruit; *bracts* membranous, ovate or lanceolate, 1–2 mm. long; *pedicels* filiform, at anthesis 1.2–2 mm. long, in fruit spreading or declined, little thickened, 2–3.5 (4) mm. long; *bracteoles* 2, attached either at base of the calyx or beneath it; *calyx* 3–4.9 mm. long (or sometimes a little accrescent and longer in fruit), strigulose with white or white and a few black hairs, the disc 0.5–0.8 (1) mm. deep, the purple-tinged, campanulate tube 1.8–2.5 mm. long, 1.5–2.2 mm. in diameter, the subulate teeth 1–2.5 mm. long, the whole becoming papery, usually ruptured, marcescent; *petals* whitish, the banner veined and the keel tipped with dull lilac; *banner* abruptly recurved through 90°, ovate- or suborbicular-cuneate, 4–7 mm. long, 3.5–5 mm. wide; *wings* 4.7–6 mm. long, the claws 1.5–1.9 mm., the lunately oval-oblanceolate or obtusely triangular, obtuse blades (3.2) 3.5–4.6 mm. long, 1.5–2.3 mm. wide; *keel* 3.6–4.4 mm. long, the claws 1.5–1.9 mm., the half-orbicular blades 2.2–2.8 mm. long, 1.5–1.9 mm. wide, abruptly incurved through 135° to the deltoid, sometimes obscurely porrect apex; *anthers* 0.3–0.5 mm. long; *pod* pendulous or (when humistrate) ascending, sessile or nearly so, sometimes tapering at base into a necklike stipe 0.2–0.8 mm. long, the body obovoid- or oblong-ellipsoid, 1–1.8 cm. long, 3.5–5 mm. in diameter, straight or a trifle arched downward, shortly cuspidate at apex, slightly obcompressed, bluntly carinate ventrally by the prominent, gently convex sutures, flattened or shallowly and openly grooved dorsally, the thin, greenish or purple-dotted, strigulose valves becoming papery, brownish-stramineous, finely cross-

reticulate, the septum nearly complete or partial, 1.2–2 mm. wide; *seeds* olive- or pinkish-brown, often purple-speckled, pitted or wrinkled, dull, (1.8) 2–2.7 mm. long.—Collections: 20 (x); representative: *Brandegee* (typotypus) *in 1878* (CAS, PH, SMU, TEX); *W. A. Weber 7795* (RSA and widely distributed, all flowering the first season); *Rusby 572* (MO, NY, ORE); *Ripley & Barneby 8358* (CAS, RSA, UTC); *Jones 5307* (NY, MO, POM, UC); *Metcalfe 144* (NMC); *Barneby 12,916* (CAS, NY, RSA).

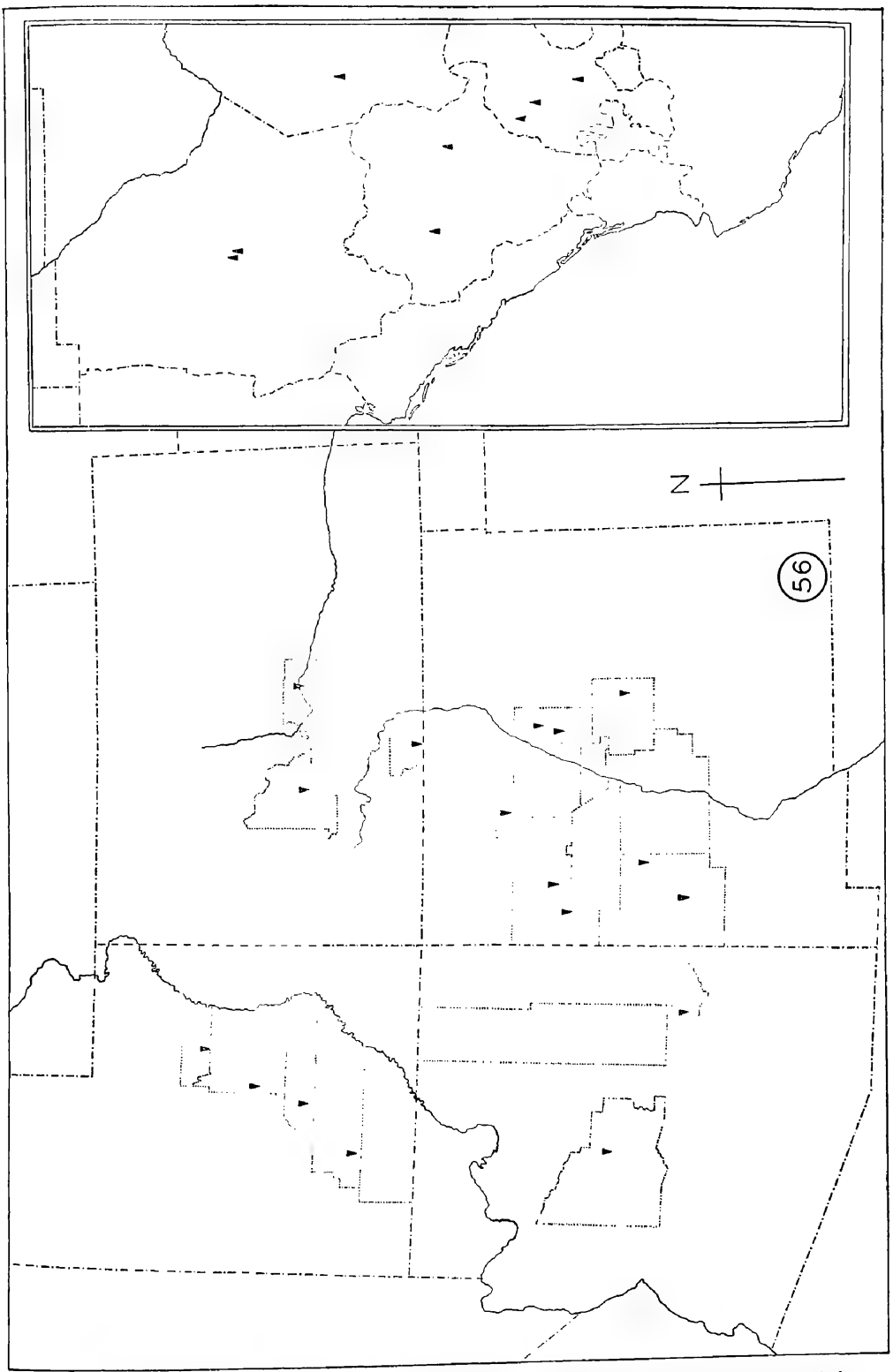
Arid, sandy or gravelly clay banks, flats and stony meadows, mostly in piñon-juniper woodland, sometimes in oak brush, rarely in yucca-grassland, most commonly on sandstone, occasionally on granitic or basaltic bedrock, 5400–8650 feet, widely dispersed but nowhere common, often occurring in scattered colonies of only a few plants, Colorado Basin from the Price River valley in Carbon County, Utah, south to the headwaters of the Verde River in Arizona; upper Gunnison Valley in Gunnison County, Colorado; upper Salt and Gila Rivers in extreme southern Navajo County, Arizona, and Gila County, New Mexico; relatively frequent on the barren crest of the Continental Divide in northwestern New Mexico, thence extending to the Conejos River in Conejos County, and the Arkansas River in Fremont County, Colorado; Pedernal Hills on the Pecos-Rio Grande divide in Torrance County, New Mexico.—Map No. 56.—May to September.

ASTRAGALUS BRANDEGEI (Townshend Stith Brandegee, 1843–1925, engineer and naturalist associated with early geological and railroad surveys in Colorado and elsewhere, especially remembered for pioneer botanical exploration in Baja California) Porter in Port. & Coult., Syn. Fl. Colo. 24. 1874.—"Banks of the Arkansas, near Cañon City, *T. S. Brandegee,* June 26, 1873."—Spm. authent., an holotypus: *Brandegee 560* ex herb. Porter., PH! isotypi, GH, MO, UC!—*Tragacantha Brandegei* (Porter) O. Kze., Rev. Gen. 943. 1891. *Atelophragma Brandegei* (Porter) Rydb. in Bull. Torr. Club 32: 660. 1905.

The Brandegee milk-vetch is a peculiar little species of strong individuality, easily recognized by its few, distant, narrow leaflets and tiny, whitish flowers strung out on threadlike peduncles. It is very inconspicuous, easily overlooked or mistaken for a sterile seedling even at full anthesis, and the species may therefore be commoner than is generally supposed. It is well adapted to flourish in arid climates where rain falls at irregular intervals and in varying amounts from one season to another. Germination of the seeds may occur at any time during the warm months whenever moisture suffices. The young plants may bear flowers and fruits within a few weeks, then consisting of a filiform taproot and a simple, erect stem only a few centimeters high and still bearing green or only newly withered cotyledons at the base. A colony of such plants was found by Dr. William A. Weber (who generously forwarded for study his large collection, cited supra) in the valley of Conejos River in Colorado. This is, however, an unusual case, for ordinarily the parent plants, veterans of two or three years duration as shown by the lignescent taproot and branched caudex, may be discovered close at hand. Such older plants commonly flower in early spring, but in New Mexico, where summer rainstorms are the rule, they continue to grow and bear flowers and fruits well into September and probably until frost. The short, one- or two-flowered peduncles, which arise in subscapose fashion from crowded nodes low on the stems, are especially common on seedling plants and on the new growth of mature ones, giving place either abruptly or by gradual transition to the elongate peduncles characteristic of a later season. The banner in the early flowers is sometimes poorly developed.

141. ASTRAGALUS QUINQUEFLORUS

Perennial but of short duration, often (perhaps always) flowering the first season, similar to *A. Brandegei* in habit, cinereously or canescently strigulose with rather coarse, straight, silvery hairs up to 0.3–0.5 (0.6) mm. long, the leaflets sometimes glabrous above; *stems* eventually numerous, usually freely branched at base, radiating from the root-crown or shortly forking caudex, (1) 2–10 (15) cm. long, the lower internodes very short, the upper ones reaching (but seldom) 2 cm. in length; *stipules* subherbaceous becoming papery, deltoid, ovate, or lanceolate, 1.5–3 mm. long, semi- or the lowest ones fully amplexicaul,



Map No. 56. Left, valleys of the Colorado, Rio Grande, and Arkansas Rivers in Utah, Arizona, Colorado, and New Mexico. Range of ◆ *A. Brandegei*. Right, parts of northwestern Mexico. Range of ▲ *A. quinqueflorus*.

free; *leaves* (2) 3–17 cm. long, with very slender petiole and rachis, and 5–11 distant, linear or linear-oblong, obtuse or retuse, folded or involute leaflets 2–20 (25) mm. long, the terminal one commonly longest; *peduncles* filiform, the lowest (often arising from short lateral spurs) 1–2.5 cm. long, the later ones elongate, up to 10 (17) cm. long, usually surpassing the foliage; *racemes* loosely 1–7-flowered, the axis little elongating, up to 3 (4) cm. long, in fruit; *bracts* ovate, 0.5–1.3 mm. long; *pedicels* very slender, ascending, straight or flexuous, at anthesis 0.6–1.5 mm., in fruit 1.6–2.4 long; *calyx* 2.6–3.6 mm. long, white-strigulose, the subsymmetrically obconic disc 0.5–0.7 mm. deep, the tube 1.5–2 mm. long, 1.3–1.6 mm. in diameter, the subulate teeth 0.8–1.6 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish with lilac wing- and keel-tips; *banner* recurved through ± 50°, oblanceolate or rhombic-ovate, shallowly notched, 4.5–5.4 mm. long, 2.8–3.8 mm. wide; *wings* 4.2–4.6 mm. long, the claws 1.5–1.8 mm., the narrowly oblong, obtuse blades ± 3–3.2 mm. long, 1–1.3 mm. wide, both incurved but the left one more abruptly and further than the right; *keel* 3.2–3.8 mm. long, the claws 1.3–1.8 mm., the half-circular blades 1.7–2 mm. long, 1.6–2.2 mm. wide, incurved through 110–120° to the deltoid, obscurely porrect apex; *anthers* 0.2–0.35 mm. long; pod pendulous (or when humistrate irregularly ascending), sessile, obliquely ovoid or oblong-ellipsoid, straight or a trifle decurved, 6–10 (11) mm. long, 3–4.5 mm. in diameter, rounded at base, contracted distally into a very short, declined, subulate, cusplike beak, laterally compressed-triquetrous, keeled ventrally by the prominent, strongly convex suture, shallowly sulcate dorsally, the lateral faces low-convex, the lateral angles obtuse, the thin, green, white-strigulose valves becoming papery, stramineous, faintly reticulate, inflexed as a very narrow partial septum 0.2–0.5 mm. wide; *seeds* brown or olivaceous, sometimes purple-speckled, wrinkled and angulate, sublustrous, 1.6–2.4 mm. long.— Collections: 10 (iv); representative: *Pringle 711* (G, K, ND, NY, P, US); *Palmer 25* (NY, US, p. p.); *Johnston 8821* (GH); *Purpus 136* (MO, POM, US); *Ripley & Barneby 13,475* (NY, RSA), *13,507* (CAS, MICH, NY, RSA, US).

Plains and valley floors, 2500–8400 feet, commonly in grama-grassland, on granitic or rarely calcareous bedrock, locally plentiful but inconspicuous and probably often overlooked, southcentral Chihuahua and western Coahuila south to Durango and Zacatecas.—Map. No. 56.—April to November, flowering either after spring or summer rains.

ASTRAGALUS QUINQUEFLORUS (five-flowered) Wats. in Proc. Amer. Acad. 21: 450. 1886. —"On the hills and plains near Chihuahua, Pringle, April 1885 (No. 234)."—Holotypus, GH! isotypi, NY, US!—*Phaca quinqueflora* (Wats.) Rydb. in N. Amer. Fl. 24: 361. 1929.

The five-flowered milk-vetch, *A. quinqueflorus,* bears a close resemblance only to the kindred *A. Brandegei* with which it shares a delicate, loosely tufted growth-habit, few, distant leaflets, and few, tiny, remotely racemose flowers tipped and faintly suffused with lilac. It differs from its relative in the shorter, subunilocular pod, which is normally more strongly compressed laterally and hence yields an obtusely triangular rather than obcompressed-reniform section. As in *A. Brandegei,* the plants flower precociously and apparently are often monocarpic although capable, when conditions are favorable, of enduring into a second year. The septum within the fruit of *A. quinqueflorus* is inconspicuous but always present and no narrower than that long recognized and described in many *Strigulosi* and *Oroboidei.*

XXXVI. Sectio INYOENSES

Slender perennials, with superficial root crown or caudex; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with ±11–19 leaflets; *flowers* racemose, early spreading and ultimately declined, small, the banner ±8.5–10.5 mm. long; *pedicels* tardily disjointing with the fruit; *calyx-tube* campanulate; *petals* purplish, little graduated, the banner recurved through ± 45°, the wings and broad, obtuse keel

subequal; *pod* declined, stipitate, firmly attached to the receptacle, the strongly incurved, ovoid-ellipsoid body long-cuspidate at apex, grooved dorsally, semibilocular below the beak, the valves leathery; *dehiscence* apical, after falling; *ovules* 17–21.—Sp. 1, xerophyte, of the desert mountains of Inyo County, California.

ASTRAGALUS sect. INYOENSES, sect. nov., *Misellis* necnon *Atratis* ut videtur affines, petalis subaequilongis et legumine in cuspidem terminalem abrupte contracto, ulterius ab his legumine incurvo (nec deorsum arcuato) absimiles.—Sp. unica: *A. inyoensis* Sheld.

The Inyo milk-vetch was aligned by Jones (1923, p. 263) with *A. (Neonix) Mulfordae* in his sect. *Hamosi*, and by Rydberg with *A. (Miselli) misellus* in the genus *Tium*. The species has some features in common with these groups, but remains an isolated monotype with no really close kindred. The declined, stipitate pod continuous with the receptacle is technically similar to that of sect. *Miselli* but is considerably modified in form and its long, terminal cusp is peculiar. The prominent broad keel, which nearly equals or even shortly surpasses the wings, has no counterpart among species related to *A. misellus*. Superficially *A. inyoensis* is suggestive of sect. *Atrati* but differs greatly in the proportion and shape of the petals and in the upward curvature of the pod. The detached flower recalls that of Sect. *Leptocarpi* subsect. *Mohavenses*, but these are piptoloboid species very different in other respects. Free stipules (inter alia) exclude the species from sect. *Neonix*.

142. ASTRAGALUS INYOENSIS

Slender, diffuse, sparsely leafy, strigulose nearly throughout with straight, appressed or subappressed hairs up to 0.35–0.55 mm. long, the stems thinly so, the herbage cinereous, but the leaflets glabrous above, densely ciliate; *stems* several or numerous, radiating from the root-crown, prostrate with ascending tips, (1) 1.5–4.5 (6) dm. long, simple or divaricately branched or spurred at 1–3 nodes preceding the first peduncle, zigzag distally in age; *stipules* 1.5–4.5 mm. long, ovate-triangular or broadly lanceolate, the lowest early becoming papery-membranous, the median and upper ones herbaceous, commonly deflexed, all ± semiamplexicaul; *leaves* divaricately spreading, 1.5–4.5 cm. long, mostly shorter than the internodes, the lowest shortly petioled, the rest subsessile, with (9) 11–19 (21) usually crowded, obovate, oblanceolate, or oblong-obovate, obtuse or retuse, conduplicate and backwardly curved leaflets (2) 3–10 mm. long; *peduncles* divaricately spreading-incurved, 2.5–7 cm. long, as long or longer than the leaf; *racemes* loosely 6–15-flowered, the axis (1.5) 2.5–7 cm. long in fruit; *bracts* submembranous, ovate-triangular, 0.8–1.5 mm. long; *pedicels* at first ascending, 0.8–2 mm. long, in fruit arched out- and downward, little thickened, 1–2.5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 3.7–5.8 mm. long, strigulose with white or mixed black and white hairs, the subsymmetric disc 0.7–1.1 mm. deep, the campanulate or somewhat vase-shaped, purplish tube 2.4–3.7 mm. long, 2–2.6 mm. in diameter, the subulate teeth 1.1–2.4 mm. long, the whole becoming papery, marcescent unruptured; *petals* pink-purple, the banner striate with purple veins; *banner* obovate-cuneate or rhombic-suborbicular, openly notched, 8.6–10.8 mm. long, 5.6–9.2 mm. wide; *wings* 7.7–9.3 mm. long, the claws 2.7–3.3 mm., the oblong-oblanceolate, obtuse, subtruncate, or obscurely emarginate, nearly straight blades 5.5–7 mm. long, 2.2–3.3 mm. wide; *keel* ± equaling the wings (0.5 mm. shorter to 0.6 mm. longer), 8.2–9.6 mm. long, the claws 3.4–4 mm., the broadly triangular to half-obovate blades 5–6.2 mm. long, (2.8) 3–3.7 mm. wide, incurved through 85–90° to the broad, blunt apex; *anthers* 0.45–0.65 mm. long, *pod* declined, stipitate, the stout, straight stipe 2–5 mm. long, the body obliquely ovoid-acuminate, 1.2–1.6 cm. long, 3.6–5 mm. in diameter, gently to very abruptly and strongly incurved through ⅛–½-circle, obcompressed-triquetrous just above the cuneate base, contracted distally into a triangular-acuminate, laterally compressed beak terminating in an erect, rigid, subulate cusp 3–4 mm. long, carinate ventrally by the prominent

suture, deeply sulcate dorsally, the somewhat fleshy, purplish, strigulose valves becoming stiffly leathery and coarsely cross-reticulate, the septum incomplete, 0.6–1 mm. wide; *seeds* ochraceous, purple-speckled, pitted but somewhat lustrous, 2.1–2.8 mm. long.—Collections: 9 (iii); representative: *Duran 3283* (CAS, DAV, NY, OB, UC, WIS, WS); *Eastwood & Howell 9615* (CAS); *Ripley & Barneby 5885* (CAS, RSA); *Barneby 11,339* (CAS, NY, RSA).

Gravelly banks, rocky streambeds, and open sandy or clay flats among sagebrush and nut pines, mostly on volcanic (perhaps sometimes calcareous) bedrock, 5000–7800 feet, locally plentiful in the desert mountains bordering Owens Valley to the east in Inyo County, California, from near Westgaard Pass southward through the Inyo Mountains to Darwin Mesa.—Map No. 50.—May to July.

ASTRAGALUS INYOENSIS (of Inyo County) Sheld. ap. Cov. in Contrib. U. S. Nat. Herb. 4 (Death Valley Rep.): 86. 1893.—"Type . . . No. 791, Death Valley Expedition; collected May 20, 1891, on the Darwin Mesa, near Mill Creek Divide, Inyo County, California, by Frederick V. Coville."—Holotypus, US! isotypi, BM, MINN!—*Tium inyoense* (Sheld.) Rydb. in N. Amer. Fl. 24: 389. 1929.

The Inyo milk-vetch was discovered by Coville at the same time and in the same place as *A. atratus* var. *mensanus,* and these two rare astragali, both endemic to Inyo County, still occur in close association on the divide between Saline and Panamint Valleys. *A. inyoensis* prefers gravelly or sandy spots bare of ground cover, where the prostrate zigzag stems, radiating in all directions from the root-crown, form symmetrical, loosely woven mats of foliage; var. *mensanus* struggles up out of the shelter of low bushes and consequently has a weak, untidy appearance. The two species, which are similar in many technical features, are easily told apart by the differently shaped flowers and different curvature of the pods.

More than half the known collections of *A. inyoensis* originated in Westgaard Pass (or Cedar Flat) where a dip in the mountain crest serves as a line demarcating the White Mountains from the Inyo Range to the south. The type station lies at its southern limit of dispersal about sixty miles distant, and one intermediate locality, on the slopes of Waucoba Peak, is on record. Probably all the material examined, which is extremely uniform in detail, was derived from three major populations.

XXXVII. Sectio JAEGERIANI

Slender, diffuse perennials, the stems arising from a buried root-crown; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with 9–15 leaflets; *flowers* racemose, nodding, small, the banner ± 7.5–10 mm. long; *pedicels* persistent or tardily disjointing with the fruit; *calyx-tube* campanulate; *petals* slightly graduated, the banner recurved through 50–75°, the keel-tip triangular, subacute, beaklike; *pod* pendulous, stipitate, persistent on the receptacle, the body linear-oblong, laterally compressed, bicarinate by the sutures, fully bilocular, the fleshy valves becoming leathery or stiffly papery; *dehiscence* apical; *ovules* 16–20.—Sp. 1, xerophyte, of the central Mohave Desert, California.

ASTRAGALUS sect. JAEGERIANI, sect. nov., sect. *Atratis* ut videtur affines sed radicis collo subterraneo, alis vexillo brevioribus, carina acutiuscula rostriformi, habituque proprio recedentes.—Sp. unica: *A. Jaegerianus* Munz.

The Jaeger milk-vetch is one those remarkable monotypes, so numerous in *Astragalus,* where modification has proceeded to a point at which obvious clues to relationship become obscure. A pod which is stipitate, laterally compressed, bicarinate by the sutures, and at the same time fully bilocular is known in America only in *A. Jaegerianus,* in *A. pachypus,* another morphologically isolated monotype, and in *A. atratus* var. *mensanus,* the species that illustrates the course of evolution from a more generalized dorsiventral compression of the pod into the highly specialized lateral one. There is something in the habit of growth, and especially in the tendency toward a downward curvature in the pod, which suggests a relationship between *A. Jaegerianus* and *A. atratus.* However, the Jaeger milk-vetch differs so greatly in its buried root-crown, in the relative proportions of the petals, and in the sharply triangular, beaklike keel-tip that only a section of its own can do justice to its unique character. Munz has already pointed

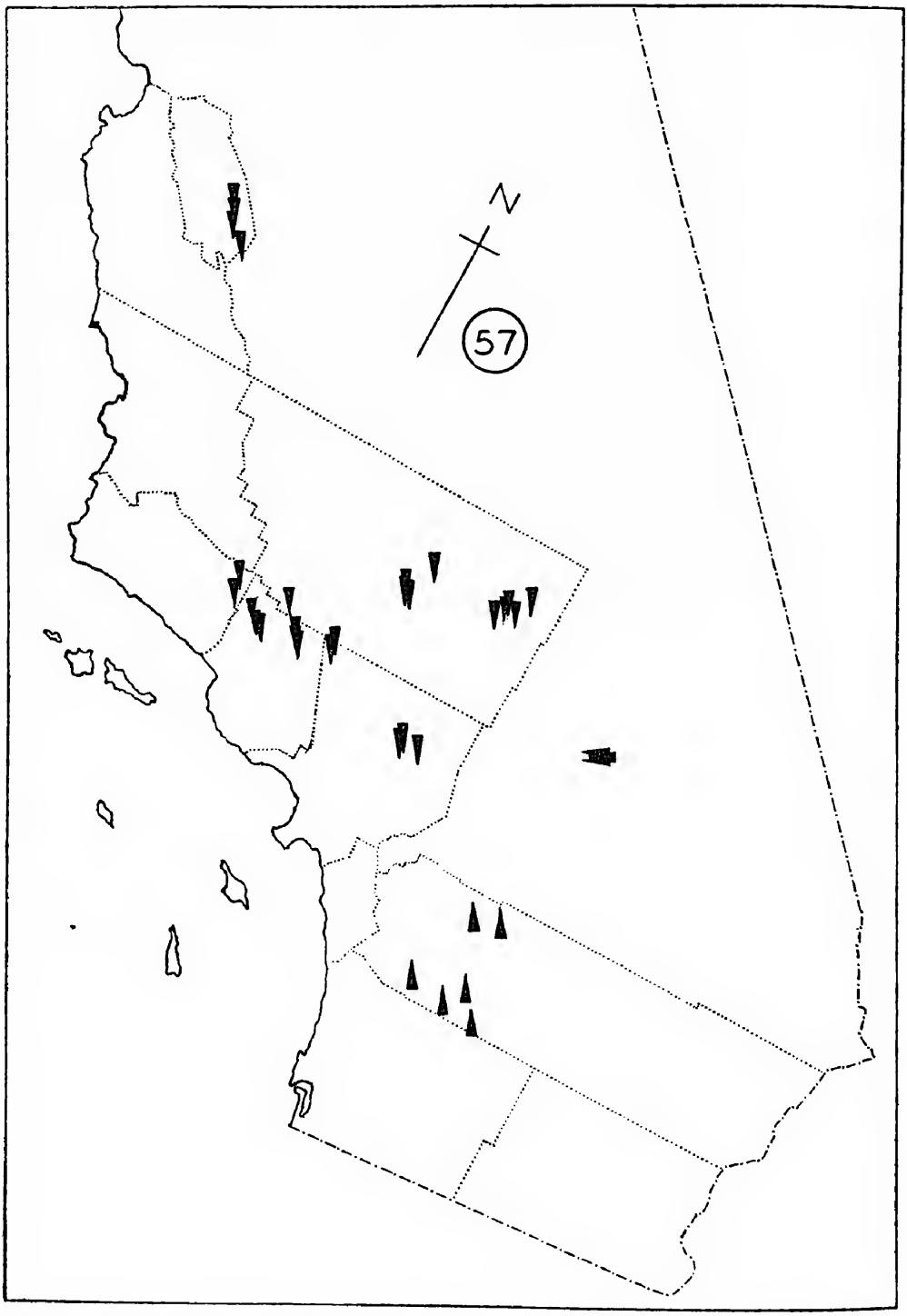
out that *A. Jaegerianus* and *A. pachypus* have similarly fashioned pods, and the two species have other small, perhaps irrelevant features in common, such as flattened scalelike hairs and leaflets usually silvery above and not beneath. In other respects they are very different, *A. pachypus* being suffruticose, with quite differently shaped flowers and fruits borne aloft on greatly thickened, persistent pedicels. The shadowy strands of kinship, which seem to link these morphologically disparate types, are mentioned at greater length under the heading of Sect. *Leptocarpi* subsect. *Tricarinati*.

143. Astragalus Jaegerianus

Sparsely leafy, tall and straggling, the cinereous or greenish herbage strigulose with fine, straight and narrowly ascending hairs up to 0.4–0.65 mm. long, the leaflets pubescent on both sides but more densely so above than beneath, the stem similarly strigulose but the hairs shorter, flattened or scalelike, sometimes partly black, the inflorescence also nigrescent; *stems* few, weak, reclining or scrambling through low shrubs, 3–7 dm. long, subterranean for a space of 1–4 cm., naked and commonly purplish at base, flexuous upward or at length abruptly zigzag, divaricately branched at 2–5 nodes preceding the first peduncle and in consequence tending to form fan-shaped sprays, the branches sometimes reduced to spurs; *stipules* 2–3.5 (5) mm. long, the lowest ones early becoming papery, ovate or oblong, strongly adnate to the rudimentary petiole and ± semiamplexicaul, the upper ones herbaceous, with deltoid-acuminate or lanceolate blades; *leaves* 2.5–5 cm. long, divaricate or reflexed, the lowest ones shortly petioled, the rest subsessile, with (7) 9–15 rather distant, linear, linear-oblong, or -lanceolate, or (in some upper leaves) subfiliform, acute or obtuse, flat or loosely folded leaflets 3–15 (20) mm. long; *peduncles* divaricate and incurved-ascending, 3–8 cm. long; *racemes* very loosely 5–15-flowered, the flowers at first ascending, declined and secund in age, the axis 1.5–7 cm. long in fruit; *bracts* membranous, lanceolate, 1.3–2 mm. long; *pedicels* at anthesis ascending, straight, 0.7–1.7 mm. long, in fruit arched downward or abruptly deflexed, somewhat thickened, 1.2–2.2 mm. long; *bracteoles* 1–2, sometimes conspicuous and up to 1.3 mm. long; *calyx* (3.6) 4–5.6 mm. long, densely and sometimes loosely black-strigulose, the subsymmetric disc 0.6–1 mm. deep, the membranous, campanulate or obconic-campanulate tube 2.5–3.8 mm. long, 2.1–2.8 mm. in diameter, the lance-subulate teeth (1.1) 1.7–2.2 mm. long, the dorsal one commonly shortest and narrowest, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* dull lavender-rose with darker veins, fading ochroleucous or sordid; *banner* (6.5) 7.5–10 mm. long, the shortly cuneate claw expanded into an ovate, oval, or inversely reniform blade (4.5) 5.5–8.8 mm. wide; *wings* 6.2–8.8 mm. long, the claws (2.6) 3–3.5 mm., the obliquely obovate blades 4–6.2 mm. long, (1.8) 2.8–3.3 mm. wide; *keel* nearly as long or a trifle longer than the wings, 6.4–8.5 mm. long, the claws 2.9–3.6 mm., the lunately triangular or lanceolate blades 3.8–5.2 mm. long, 2–2.8 mm. wide, abruptly incurved through 80–95° to the triangular, acute or subacute, often slightly porrect apex; *anthers* 0.45–0.6 mm. long; *pod* pendulous, stipitate, the straight stipe 3–5 mm. long, the linear-oblong body 1.6–2.3 cm. long, 3.5–5 mm. in diameter, straight or a trifle decurved, cuneately tapering at base, abruptly contracted distally into the mucronate beak, bicarinate by the thickened, salient, often undulate sutures, the lateral faces at first plumply convex but shrinking to low-convex or almost flat, the glabrous, reddish, or green and red-mottled valves becoming brown, leathery or stiffly papery, rugulose-reticulate, the septum 3–4.5 mm. wide, extending up to the base of the unilocular beak; *seeds* unknown.—Collections: 5 (i); representative: *Munz 16,581* (DS, POM, WS); *Ripley & Barneby 3297* (NY, RSA).

Dry stony hillsides and desert mesas, in granite sand and gravel, commonly with Joshua trees, nearly always taking shelter under and scrambling up through low shrubs, 3000–3800 feet, very local but forming colonies, known only from

the central Mohave Desert between Barstow and Goldstone, San Bernardino County, California.—Map No. 57.—April to June.



Map No. 57. California, southward from Monterey Bay. Range of *A. pachypus*: ▼ var. *pachypus*, and ▲ var. *Jaegeri*; and of ♦ *A. Jaegerianus*.

ASTRAGALUS JAEGERIANUS (Edmund Carroll Jaeger, 1887–) Munz in Leafl. West. Bot. 3: 49. 1941.—"2 miles south of Jay Mine, about 12 miles south of Goldstone and 30 miles northeast of Yermo, Mohave Desert, San Bernardino Co., California, April 26, 1941, at about 3000 ft., *Munz No. 16580* . . ."—Holotypus, POM! isotypi, CAS, GH, K, MO, WS!

Astragalus dumetorum (of thorn-thickets) Jaeger, Desert Wild Flowers 119, fig. 251. 1940, nom. provis.; non Hand.-Mazz., 1933.

The Jaeger milk-vetch is an object of curiosity rather than one of beauty. The long, weak, usually free-branching stems are somewhat brittle and difficult to disentangle without injury from the stiff protection of the desert shrubs. The divaricate or recurved leaves, which are remarkably short in relation to the flexuous or zigzag internodes, are an immediately noticeable feature. The flowers were described by Munz as ochroleucous, or purplish and purple-veined turning ochroleucous in age. They seem to be variable in color; as seen on Coolgardie Mesa the newly expanded petals were ochroleucous veined with purple, turning lurid, brownish- or violet-purple as they aged. The pendulous pods resemble those of *A. filipes* in shape. They are fleshy and lustrous in the fresh state, either red or variegated with red and green, but turn brown in ripening. The known range of the species hardly exceeds ten miles in diameter. It was first collected in the second week of April, 1939, at points six and ten miles northwest of Paradise Rocks, by Edmund Jaeger (DS, POM).

XXXVIII. Sectio PACHYPODES

Tall, caulescent perennials, the stems arising from the superficial crown of a woody taproot, persisting at base as an aerial caudex; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with 11–27 narrow, distant leaflets; *flowers* racemose, ascending, rather large, the banner 15–22 mm. long; *pedicels* thickened-persistent; *calyx-tube* campanulate; *petals* white or lemon-yellow, regularly graduated, the keel-tip obtuse; *pod* incurved-ascending, persistent, stipitate, the oblong-cylindric body becoming laterally compressed, bicarinate by the salient sutures, the fleshy valves becoming leathery or subligneous, inflexed as a complete septum; *dehiscence* apical, through the gaping beak; *ovules* 20–36.—Sp. 1, xerophyte, of the Inner South Coast Ranges and western Mohave Desert, California, extending (as a var.) into interior southern California.

ASTRAGALUS sect. PACHYPODES (Jones), comb. nov., based on *Astragalus* sect. *Podosclerocarpi* subsect. *Pachypodes* Jones, Rev. Astrag. 144. 1923, in clave, exclus. spp. nonnull.—Sp. typica: *A. pachypus* Greene.—*Brachyphragma* sect. *Pachypoda* (Jones) Rydb. in N. Amer. Fl. 24: 399, in clave. 1929.

144. ASTRAGALUS PACHYPUS

Handsome, commonly robust, rather rigid, sparsely leafy, bushy-branched, strigulose nearly throughout with appressed, filiform or mostly flattened and scale-like hairs up to 0.4–0.6 (0.7) mm. long, the stems and usually the upper surface of the leaflets very densely so, silvery-white, the leaflets more thinly pubescent beneath, greenish or cinerous; *stems* several or numerous, erect and ascending in clumps (rarely decumbent and trailing on steep banks), usually stout and striate, (1.5) 2–5.5 (8) dm. long, simple or branched at either 1–3 nodes preceding the first peduncle, or at base only, flexuous and often abruptly zigzag distally; *stipules* 1.5–5.5 mm. long, decurrent around about half the stem's circumference, the short, deltoid or deltoid-acuminate, erect or deflexed blades mostly shorter than their wide bases, glabrate dorsally or at least less densely pubescent than the stems, forming a contrasting yellowish spot at each node, ultimately papery and deciduous, the margins beset with a few clavate processes; *leaves* (2.5) 5–15 (16.5) cm. long, shortly petioled or the uppermost subsessile, with stiff, often long-persistent rachis and 11–27 rather distant, linear or linear-oblong, retuse, truncate-emarginate, or exceptionally subacute, at least marginally involute, thick-textured leaflets (3) 5–25 (34) mm. long; *peduncles* stout, stiffly erect, (0.5) 0.7–2 dm. long, nearly always surpassing the leaves; *racemes* loosely (4) 5–20 (28)-flowered, the axis (2) 3–13

cm. long in fruit; *bracts* scarious, ovate or ovate-acuminate, 0.7–2.5 mm. long; *pedicels* ascending, stout, straight or nearly so, at anthesis 0.9–3 mm., in fruit thickened and 1.5–5.5 mm. long; *bracteoles* 2, minute, rarely 0; *calyx* 5.5–9.5 mm. long, strigulose with black, mixed black and white, or rarely all white hairs, the slightly oblique disc 1.1–1.8 mm. deep, the broadly campanulate tube 3.6–5.2 mm. long, 3.6–5 mm. in diameter, the broadly subulate teeth (1.5) 1.8–4.3 mm. long; *petals* clear white, sometimes pink- or lavender-tinged, or lemon-yellow; *banner* at full anthesis recurved through about 45°, sometimes further in withering, broadly rhombic-ovate or -elliptic, shallowly or deeply notched, 15–22 mm. long; *wings* 14–18 mm. long, the oblong-oblanceolate or narrowly oblanceolate, obtuse or obscurely emarginate, gently incurved blades 7.2–13 mm. long, their inner margins more or less involute or crimped; *keel* 10.7–15.3 mm. long, the lunately half-elliptic blades 6.7–10.3 mm. long, 2.7–4.2 mm. wide, rather gently incurved through 50–95° to the triangular, ultimately obtuse, often obscurely porrect apex; *stipe* of the *pod* stout, straight, horizontally spreading or ascending at a wide angle, 4–8 mm. long, the body lunately or falcately oblong-cylindric, incurved to the perpendicular or nearly so, (1.2) 1.5–2.5 (2.8) cm. long, 4–7.5 mm. in diameter, cuneately contracted at base, and at apex into a short, rigid cusp, when first formed terete, solid, fleshy, becoming strongly compressed laterally when ripe, the prominent, thick, cordlike sutures then salient, the lateral faces low-convex, the green, glabrous, lustrous valves becoming stiffly leathery or subligneous, stramineous or brownish, both transversely reticulate and wrinkled lengthwise, the septum (2.7) 3.5–6 mm. wide, complete below the unilocular beak; *seeds* brown, greenish-brown and purple-dotted, rarely blackish-purple, punctate but somewhat lustrous, 3.1–4.6 mm. long.

Key to the Varieties of A. pachypus

1. Flowers large, the calyx-tube 4.5–5.2 mm., the banner 17–22 mm., the keel 12.3–15.3 mm. long; *petals* white, rarely suffused with pink or lilac (but drying yellowish); *leaflets* 11–19 (21); Kern and Ventura Counties n.-ward ..... 144a. var. *pachypus*
1. Flowers a little smaller, the calyx-tube 3.7–4.3 mm., the banner 15–17 mm., the keel 10.7–12.6 mm. long; *petals* clear lemon-yellow when fresh; *leaflets* (15) 17–25 (27); Riverside County ..... 144b. var. *Jaegeri*

144a. Astragalus pachypus var. pachypus

Characters as given in the key; *pedicels* at anthesis (1) 1.5–3 mm., in fruit (1.5) 2–5.5 mm. long; *calyx-tube* 4.3–5 mm. in diameter, the teeth (1.5) 2.7-4.3 mm. long; *banner* 9–14.5 mm. wide; *wings* 14.3–18 mm. long, the claws 5.4–7 mm., the blades 9.9–13 mm. long, 3–4.5 (5) mm. wide; *keel-claws* 5.5–7.1 mm. long, the blades 7.7–10.3 mm. long, 3.4–4.2 mm. wide; *anthers* (0.65) 0.7–1.1 mm. long. Collections: 39 (iii); representative: *Clokey & Anderson 6693* (CAS, NY, POM, WS); *C. B. Wolf 11,131* (CAS, NY, TEX); *Elmer 3994* (NY, POM, WIS); *L. S. Rose 38,172* (CAS, NY); *Ripley & Barneby 5860* (CAS, RSA).

Open hillsides and brushy flats, in gravelly clay or shaley soils, especially about shale or sandstone outcrops, sometimes on granites, 1650–6300 feet, locally plentiful, often with digger pine, in the foothills about the head of San Joaquin Valley in northern Ventura, extreme northern Los Angeles, southwestern Kern, and northeastern Santa Barbara Counties, California, extending east to the edge of the Mohave Desert about Ricardo, Kern County, and in Antelope Valley, Los Angeles County; isolated in the inner South Coast Range in San Benito County (Griswold Hills; Idria to Panoche).—Map No. 57.—March to June (July), the fruit long persisting.

ASTRAGALUS PACHYPUS (with thick stipe) Greene in Bull. Calif. Acad. Sci. 1: 157. 1885. —"Mountains of Kern County, California, June, 1884, Mrs. Curran."—Holotypus, collected at Bealville, Kern County, CAS!—*Brachyphragma pachypus* (Greene) Rydb. in N. Amer. Fl. 24: 401. 1929.

The typical form of the bush milk-vetch, var. *pachypus*, is a handsome plant when newly come into bloom, easily recognized by its stiff, striate stems whitened by a coat of parallel, contiguous hairs, by its distant, linear leaflets silvery-pubescent above and greenish or ashen beneath, and by the amply proportioned, firm-textured flowers which are clear white, except in rare forms having a faint blush of rose or lilac at the base of the banner and wings. The pod, which spreads horizontally at base but is brought distally into a vertical position by the inward curvature, is terete when first fully formed, the lateral compression being achieved by inward collapse of the fleshy valves coincident with a stiffening of the sutures.

The var. *pachypus* is subject to little variation. Around the head of San Joaquin Valley and eastward to the desert edge, the ripe pod is relatively broad, about 5–7.5 mm. in diameter. The material from San Benito County (representative: *Abrams 7959*, NY, US; *G. S. Lyon 1645*, CAS; *Stebbins & al. 5077*, CAS, DAV) has more slender fruits about 4–5 mm. in diameter, but the plants do not seem to differ significantly in other ways.

144b. ASTRAGALUS PACHYPUS var. JAEGERI

Characters as given in the key; *pedicels* at anthesis 0.9–1.7 mm., in fruit 1.5–2.7 mm. long; *calyx-tube* 3.6–4 mm. in diameter, the teeth 1.8–2.8 mm. long; *banner* 7.2–9 mm. wide; *wings* 14–15 mm. long, the claws 5–6.5 mm., the blades 9–9.7 mm. long, 2.7–3.1 mm. wide; *keel-claws* 4.9–6.3 mm., the blades 6.7–7.4 mm. long, 2.7–3.1 mm. wide; *anthers* 0.6–0.8 mm. long.—Collections: 10 (i); representative: *S. B. Parish 1234* (ND, POM); *Munz 5118* (POM); *Peirson 2205* (RSA); *M. F. Spencer 1771* (OB, POM); *Ripley & Barneby 407/37* (K).

Dry ridges and open sandy slopes in grassland and oak-chaparral, 1700–2500 feet, local, known only from west Riverside County, California, from the northwest foothills of the San Jacinto Mountains near Banning south to the Temecula River. —Map No. 57.—December to June.

ASTRAGALUS PACHYPUS var. JAEGERI (Edmund Carroll Jaeger, 1887–) Munz & McB. ex Munz in Bull. S. Calif. Acad. Sci. 31: 67. 1932.—"Type, from dry slopes on divide east of Dripping Springs, Riverside County, at 1700 feet, *Munz* 9842 . . . ."—Holotypus, collected 20 May, 1925, POM!

Narrowly endemic to the arid valleys just west of the desert in Riverside County, Jaeger's bush milk-vetch differs from var. *pachypus* in a number of small characters, none of them important when considered severally, but distinctive enough in aggregate. The flowers slightly smaller in all average measurements and the many leaflets are the features most easily observed in dry specimens. In the living state the petals (as observed near Sage, Riverside County, in 1936) are clear lemon-yellow, strikingly different from the white or faintly roseate coloring of the typical form. However, since the white flower of var. *pachypus* turns ochroleucous or yellowish in drying, a useful distinction is lost in the herbarium. The one collection of var. *Jaegeri* known to Jepson (1936, p. 362) was not recognized as different from var. *pachypus*, although he particularly noted the locality (Dripping Springs, *Peirson*) as mystifying in relation to the known dispersal of the species around the head of San Joaquin Valley. The range of var. *pachypus* has since been extended east to the edge of the desert and north in the Coast Range to San Benito County, but it still conforms to an established distributional pattern, provided that var. *Jaegeri* is recognized as distinct.

XXXIX. Sectio DRUMMONDIANI

Robust, caulescent perennials, with superficial or shallowly buried root-crown; *vesture* basifixed, villous-hirsute, the hairs minutely bulbous-based; *stipules* either all free, or some of the lowest fully amplexicaul and connate, the sheath commonly ruptured early; *leaves* imparipinnate, with 17–33 leaflets; *flowers* loosely racemose, nodding, rather large, the banner 18.5–26 mm. long; fertile *pedicels* thickened-persistent or tardily deciduous with the fruit; *calyx-tube* deeply campanulate, often

subtumid, oblique but scarcely gibbous at base; *petals* whitish, regularly graduated, the deltoid keel-tip lilac-maculate; *pod* pendulous, stipitate, continuous with the receptacle, the elongate body linear or linear-oblanceolate in profile, straight or gently curved, triquetrously compressed, with convex lateral and grooved dorsal faces, bilocular or nearly so below the short beak, the somewhat fleshy valves becoming stiffly papery; *dehiscence* apical, tardy; *ovules* 14–30.—Sp. 1, xerophyte, of the Rocky Mountains and higher prairies, New Mexico to southern Canada, extending feebly west of the Continental Divide from Idaho to Utah.

ASTRAGALUS sect. DRUMMONDIANI, sect. nov. affinitatis dubiae, habitu *Collinos* nonnullos referens sed legumine triquetrim compresso biloculari valde diversi, stipulis nunc infimis connatis *Tiopsideos* simulantes sed ab eis ob caules omnes ex ipso radicis collo erectos necnon pubem e pilis patulis longis basi minutim incrassatis prorsus absimiles. Species unica cum *A. racemoso* olim in sect. *Galegiformibus* consociata, sed legumen illius uniloculare est.—Sp. unica: *A. Drummondii* Dougl.

The affinities of the Drummond milk-vetch, for which a monotypic section is here proposed, are doubtful and open to interpretations which will vary according to the value assigned to certain morphological characters as indices of relationship. A notable feature of the species are the membranous stipules, all semiamplexicaul and free in some populations and in others connate at the lower nodes, especially when these nodes are buried a few centimeters underground. Individual plants with some connate stipules have much in common with *A. scopulorum,* which may be the nearest surviving relative of *A. Drummondii.* The large, nodding flowers and the stipitate, bilocular pod of *A. scopulorum* are technically similar to those of *A. Drummondii,* but its diffuse stems arise to the surface after a considerable horizontal or obliquely ascending growth below ground; the plants in consequence have the habit of most *Scytocarpi* and *Strigulosi,* very different from the erect, bushily clumped *A. Drummondii,* with all stems originating together from a knotty root-crown. The latter is also remarkable and easily recognized everywhere by its shaggy vesture of long, spreading hairs minutely thickened at base. Individuals with stipules all free might be likened to the *Collini,* although the pod is triquetrous and bilocular, not unilocular and laterally flattened. If connate stipules are thought to be accidental in the species and not of phylogenetic import, it is necessary to consider the possibility that *A. Drummondii* is related to the *Miselli,* a group of much smaller-flowered species, largely of the intermountain region; these, however, have a shallowly campanulate calyx-tube, not at all tumid and not greatly oblique at base, and together form a homogeneous group in which *A. Drummondii* must appear quite out of place.

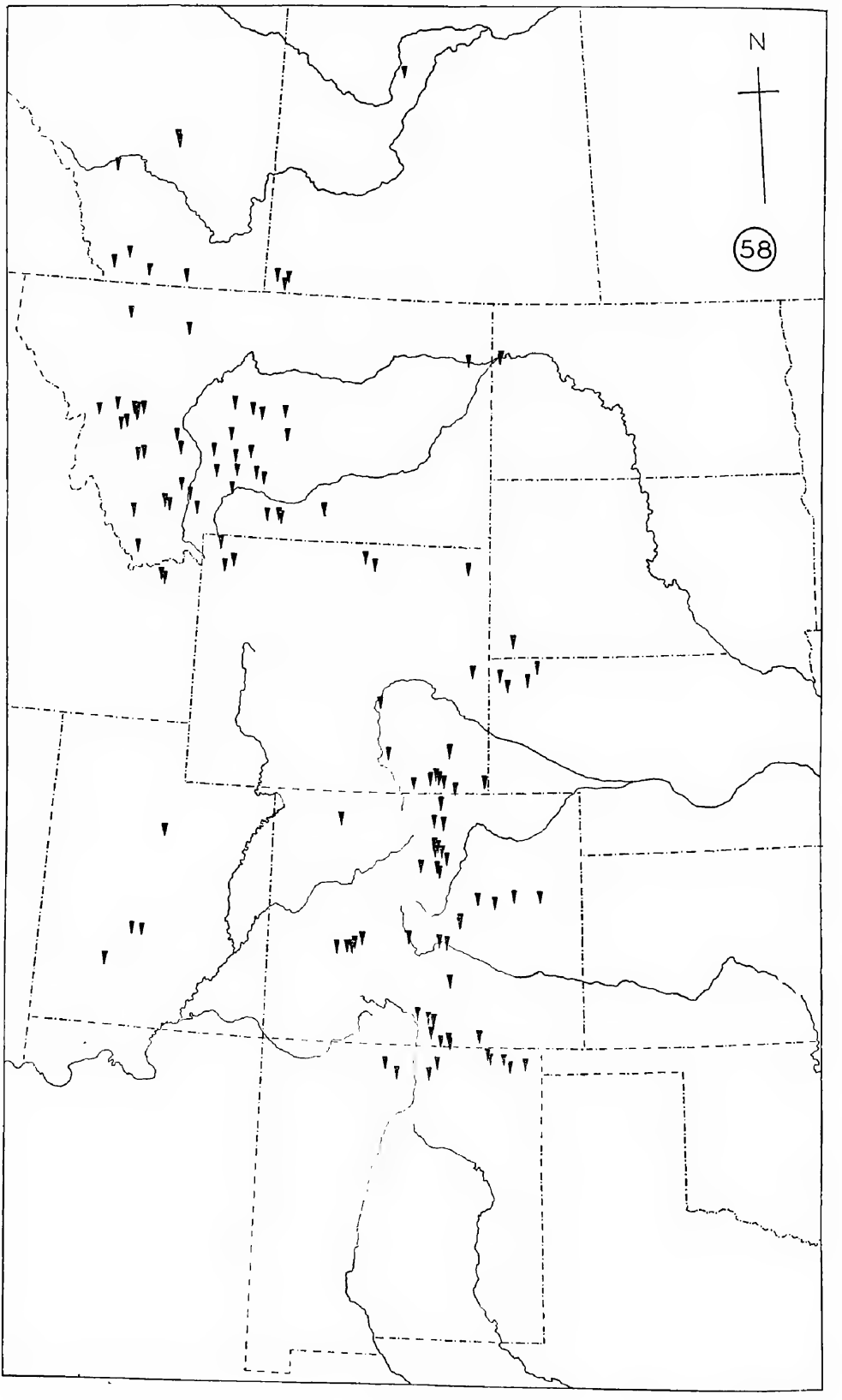
Although *A. Drummondii* is so distinct a monotype, it has traditionally been associated with *A. racemosus,* in the first instance by Gray (1864, p. 200) in a section *Galegiformes,* to which Jones later (1923, p. 247) added *A. scopulorum,* and which was taken over by Rydberg (1929, p. 386) as *Tium* sect. *Racemosa.* Gray pointed out that *A. racemosus* has an essentially unilocular pod. We have since learned that *A. racemosus* is seleniferous, as *A. Drummondii* is not; and despite a superficial similarity in their coarsely leafy habit and nodding flowers of rather large size, they are not at all closely related. Elsewhere *A. racemosus* has been chosen lectotypus of sect. *Galegiformes,* leaving the present species with no sectional resting-place.

145. ASTRAGALUS DRUMMONDII

Commonly coarse and leafy, with a woody taproot and knotty, pluricipital root-crown at or shortly below soil-level, villous-hirsute with filiform, minutely bulbous-based, spreading and ascending, the straight or sinuous hairs up to 1.1–1.8 (2) mm. long, the stems and lower leaf-surface pallidly gray-green beneath the ashen vesture, the leaflets bicolored, brighter green and glabrous or medially glabrescent above, the inflorescence more shortly and often more thinly pubescent than the rest; *stems* several or many, erect or ascending in clumps, (2.5) 3–5.5 dm. long, usually stout, angular-ribbed and fistular, at base naked, simple, subterranean for a space of 0–6 cm., branched or spurred at (1) 2–6 nodes preceding the first peduncle; *stipules* submembranous, early becoming papery-scarious, (2) 3–12 mm. long, the lowest of two sorts: a) decurrent around ⅓–⅔ the stem's circumference and free, or b) fully amplexicaul and connate into a bidentate sheath, in either

case fragile and often irregularly ruptured early in the season, the median and upper ones always free, deltoid- or lance-acuminate, with narrow, often caudately attenuate, spreading or deflexed blades; *leaves* 4–10 (13) cm. long, all but the lowest ones subsessile, with (13) 17–33 often scattered and irregularly inserted, oval-oblong, oblong-oblanceolate, or obovate, obtuse, truncate, or emarginate, flat or loosely folded leaflets 4–25 (33) mm. long; *peduncles* stout, erect, (4) 6–12 cm. long, longer or shorter than the leaf; *racemes* 14–30 (35)-flowered, loose or early becoming so, the flowers early nodding, the axis elongating, (3) 5–15 (22) cm. long in fruit; *bracts* membranous, pallid, lanceolate, 2–5 mm. long; *pedicels* at anthesis ascending or somewhat spreading, 1.5–2.5 (3) mm. long, in fruit usually arched through 90°, (2) 3–5 mm. long; *bracteoles* 0–2; *calyx* 7–12.5 mm. long, strigulose-villosulous with black, white, or mixed hairs, the oblique disc 0.9–1.5 (2) mm. deep, the membranous, pallid, deeply campanulate tube (4.7) 5.5–8 mm. long, (2.9) 3.5–5.1 mm. in diameter, commonly a little tumid but not or scarcely gibbous dorsally at base, the subulate teeth (1.7) 2–4.5 (5) mm. long; *petals* white or pale cream-colored, the keel tipped with dull lilac; *banner* recurved through about 45°, oblanceolate, rhombic-oblanceolate, or -elliptic, 18.5–26 mm. long, 7–10.5 mm. wide; *wings* 15–21 mm. long, the claws 7–9 mm., the oblong oblanceolate or -elliptic, straight or slightly incurved blades (8.7) 9–12 mm. long, 2.3–3.3 (3.8) mm. wide, commonly obliquely truncate and notched on the lower side just below the obtuse or subacute apex; *keel* 12–15 mm. long, the claws (6.5) 7–8.7 mm., the half-obovate blades 5.4–7 mm. long, 2.6–3.3 mm. wide, abruptly incurved through 90–105° to the deltoid, sometimes obscurely porrect apex; *anthers* (0.5) 0.55–0.75 (0.8) mm. long; *pod* pendulous, stipitate, the slender, straight stipe (5) 6–11 (14) mm. long, the body linear-oblong or -oblanceolate in profile, 1.7–3.2 cm. long, 3.5–5.5 mm. in diameter, usually bent downward from its junction with the stipe, thereafter straight or gently either incurved or decurved, cuneate at both ends or sometimes tapering basally into the stipe, obliquely cuspidate at apex, subtriquetrously compressed, keeled ventrally by the prominent, usually purplish-brown suture, the lateral faces high-convex, the dorsal face deeply and narrowly sulcate, the green, somewhat fleshy, glabrous valves becoming stiffly papery or almost leathery, stramineous, cross-reticulate, somewhat torulose when fully ripe, inflexed as a complete or nearly complete septum 0.6–1.5 mm. wide; *ovules* (14) 16–26 (30); *seeds* brown or soot-brown, sparsely pitted but somewhat lustrous, 2-3 mm. long.—Collections: 144 (x); representative: *Moodie 968* (CAS) 1159 (NY); *Macoun & Herriot 70,482* (CAS, ND, NY); *Hitchcock & Muhlick 9120* (CAS, NY, WS, WTU), *12,058* (NY, RSA); *A. & E. Nelson 5747* (NY); *Osterhout & Clokey 3111* (CAS, TEX); *Ripley & Barneby 7170* (CAS, RSA), *9233* (RSA, UTC), *10,292a* (CAS, RSA); *Jones 5434* (NY, POM); *Eggleston 20,081, 20,491* (NY).

Open hills and plains, in grassland, oak brush, sagebrush, piñon-juniper woodland or rarely pine forest, in light dry or moderately moist and heavy alluvial soils, with no apparent rock preference, 2200–8600 feet, widespread, common, and often locally abundant at middle elevations on the east slope of the Rocky Mountains and the higher prairies, from southern Alberta south to the head of the Canadian River and upper Rio Grande in northeastern and northcentral New Mexico, extending east over the plains to southern Saskatchewan, western North Dakota, the Black Hills in South Dakota, and eastern Colorado; also west of the Continental Divide but there common only in western Montana, from the Blackfoot River and Clarks Fork south just into southeastern Idaho (Clark County); rare and occasional in the Yampa and Gunnison Valleys, Colorado; apparently isolated in central Utah (Utah, Beaver, and Sevier Counties).—Map. No. 58.—May to August.


N
58

ASTRAGALUS DRUMMONDII (Thomas Drummond, –1835, pioneer plant collector in the Canadian Rocky Mountains, 1825–7) Dougl. ex Hook., Fl. Bor.-Amer. 1: 153, tab. LVII. 1831.—"First, I believe, gathered by Mr. Wright, very many years ago, in Hudson's Bay (Herb. nostr.). Eagle and Red-Deer Hills of the Saskatchewan, *Douglas.*"—Holotypus, *Douglas in 1826,* K! Paratypus (*Wright,* but certainly not strictly from Hudson Bay), K!—*Tragacantha Drummondii* (Dougl.) O. Kze., Rev. Gen. 944. 1891. *Tium Drummondii* (Dougl.) Rydb. in Bull. Torr. Club 32: 659. 1905.

Astragalus Drummondii fma. *melanocalyx* (with black-hairy calyx) Gand. in Bull. Soc. Bot. Fr. 48: xv. 1902—"Hab. Colorado, ad Fort Collins (C. Crandall)."—Holotypus, collected May 7, 1898, LY!

The Drummond milk-vetch is a handsome, sturdy plant with hollow, ribbed stems, shaggy as are the leaves, with long, often sinuous hairs, and abundant, nodding flowers, whitish with lilac keel-tip. The flowers give rise to long, pendulous pods elevated out of the calyx on a stipe as long or up to twice longer than the tube. When first formed the pod is green and lustrous, keeled ventrally by a thick, commonly brownish-purple suture; the valves turn straw-color in ripening, when they are often a little constricted between the seeds. As the only tall and erect astragalus with hirsute foliage in its range of dispersal, *A. Drummondii* is easily recognized and almost never misnamed. Apart from the dimorphic stipules, a feature very unusual in the genus, and some fluctuation in stature and flower-size, such as must be expected in any far-ranging species, the Drummond milk-vetch varies little. Forms with partly black-hairy inflorescence are most common, but others with all black (fma. *melanocalyx)* or all white hairs are not infrequent.

Douglas and Drummond seem to have collected *A. Drummondii* almost simultaneously, Drummond at Carlton House (K), Douglas in Alberta. The two collectors sailed together from Hudson Bay to England in the fall of 1827, and the name of the species remains to remind us of their friendship.

XL. Sectio MALACI

Caulescent perennials, of low or moderate stature, with either superficial or shallowly buried root-crown; *vesture* basifixed, strigulose, hirsute, or villous-hirsutulous, sometimes almost lacking; *stipules* dimorphic, the lowest large, ovate, obtuse, several-nerved, amplexicaul (often imbricated), the upper cauline ones narrower, all free; *leaves* imparipinnate, with 9–25 leaflets; *flowers* racemose, ascending or declined, of medium size, the banner 12–20 mm. long; *calyx-tube* deeply campanulate or cylindric; *petals* reddish-violet, pink-purple, pallid and suffused with lurid purple, rarely white, regularly graduated, the banner recurved through ±45°, the keel-tip obtuse; *pod* variably oriented (deflexed, humistrate and ascending, or erect), stipitate or subsessile, continuous with the receptacle and falling (except in *A. Minthorniae)* with the disjointing pedicel, the body narrowly oblong, oblong-ellipsoid, or cylindric, crescentically incurved to almost straight, either trigonously, laterally, or dorsiventrally compressed, mostly bi- *(A. cibarius* subuni-) locular, the valves becoming papery or leathery (in *A. cimae* var. *sufflatus* papery and inflated); *dehiscence* apical, often tardy, through the beak, the walls of the septum also tardily separating; *ovules* 16–36.—Spp. 8, xerophytes, of the Great Basin and Snake River Plains in Nevada, extreme eastern California, southwestern Utah, eastern Oregon, and southwestern Idaho, 2 of the Mohave Desert and Death Valley region in California, 1 of the Grand Canyon of the Snake River, 1 extending north and east into western Montana, southcentral Wyoming, and western Colorado.

The six species of sect. *Malaci* known to Rydberg were dispersed by him (1929, passim) through nearly as many genera, namely *Xylophacos (A. cibarius), Hamosa (A. ensiformis, A. malacus, A. Minthorniae,* but only the two last in the same section), *Hesperonix (A. vallaris)* and *Phacomene (A. cimae).* Reassembled here, together with *A. chamaemeniscus* and *A. malacoides,* they form a loosely knit group of species, each of which is manifestly related to one other, despite an extraordinary diversity in shape and compression of the fruit. The section is one of several built up by accretion, and as usual in these cases the peripheral members diverge widely from one another. The key species which serves as a nucleus to sect.

Map No. 58. The Rocky Mountain and Prairie States and Provinces. Range of *A. Drummondii.*

Malaci is *A. cibarius;* it possesses the large, veiny lower stipules characteristic of the group, but the pod is unusual in being dorsiventrally compressed and at the same time subunilocular, while the stipe is reduced as often as not to a thick neck scarcely longer than wide. Its carpological peculiarities entitle it to a monotypic subsection. From *A. cibarius* we proceed by comparatively small but important steps in two directions: firstly to the *Vallares,* two species of greatly restricted range which resemble *A. cibarius* in all features of any moment up to the pod, which is still obcompressed but long-stipitate and fully bilocular; and secondly to the *Ensiformes,* of which the pod remains very shortly stipitate but early becomes laterally flattened and two-sided when ripe or is at least, even when little compressed, bicarinate by the sutures when fully mature. The member of subsect. *Ensiformes* most closely resembling *A. cibarius* is the very rare *A. ensiformis* itself. So closely does it simulate its common relative in details of habit, vesture, and individual flowers that even Jones mistook it in the field for *A. cibarius.* Probably we should regard the modification of the fruit from a dorsiventral to a lateral compression as a function of the septum's width. When first formed, the pods of *A. ensiformis* and *A. Minthorniae* are terete or nearly so. As the fruit ripens and the fleshy tissues of the valves dry out, the lateral walls collapse inward. The wide septum serves as a buttress across the vertical diameter of the cavity so that the sutures are forced to remain apart and eventually become externally prominent. However, the pod of *A. malacoides,* a species intermediate in some respects between subsect. *Ensiformes* and the genuine *Malaci,* is laterally compressed and two-sided from an early stage of development.

The true *Malaci* consist of only two species, *A. malacus* and *A. chamaemeniscus,* differing collectively from those hitherto mentioned in having sharply trigonous pods at once grooved dorsally and fully bilocular, and contracted at base into a short, often overlooked stipe like that found in *A. cibarius.* If we lacked *A. malacoides,* which combines the growth-habit of *A. chamaemeniscus* and the vesture and flower of *A. malacus* with a laterally compressed fruit, we would be justified in setting off the genuine *Malaci,* which until recently appeared greatly isolated, in a section of their own. It is of interest that Jones (1923) perceived the relationship of *A. malacus* to *A. ensiformis* long before the connecting link of *A. malacoides* was discovered. However Jones's sect. *Malaci* is otherwise very heterogeneous, consisting of piptoloboid species scattered in these pages among sects. *Argophylli (A. Parryi, A. feensis), Layneani (A. Layneae)* and *Succumbentes (A. succumbens).* Rydberg referred to his more narrowly defined *Hamosa* sect. *Malacae* an even more anomalous element in *A. (Chaetodontes) Andersonii* which differs in having truly sessile, deciduous pods and connate-sheathing stipules.

The sect. *Malaci* appears to have reached a mature evolutionary stage at which all the species are mutually separated by wide morphological discontinuities, and even such geographical varieties as exist can be defined in unusually precise terms. Age and isolation are so often associated that it is no surprise to find that the affinities of the group in the genus are difficult to discern. They are assumed to lie in the general direction of sect. *Reventi-Arrecti,* of which the representative species resemble our subsect. *Vallares,* although differing in their erect stems and erect, subunilocular, dorsiventrally compressed pods dehiscent on the raceme. In sect. *Malaci* only *A. Minthorniae* has long-persistent fruits (in the rest the pod falls with the pedicel and dehisces on the ground) combined with stems and peduncles both erect, but here the pod is fully bilocular and laterally compressed. Probably the similarities are coincidental.

The species of sect. *Malaci,* as already indicated, fall into four groups easily defined in terms of the fruit:

Key to the Subsections of Sect. Malaci

1. Ovary and (uni- or bilocular, laterally or dorsiventrally compressed) pod pubescent, the ripe fruit subsessile or shortly stipitate, the stipe not over 3 mm. long (2)
   2. Pod dorsiventrally compressed or at least ventrally depressed or flattened from the first or permanently, subunilocular, the septum, when present, very narrow and incomplete. Racemes shortly 4–15-flowered, the axis little elongating, 0.5–1.5 cm. long in fruit; centr. Utah and n.-e. Nevada to s.-centr. Idaho, w. Montana, s.-centr. Wyoming, and n.-w. Colorado ..... XL (i). Subsect. *Cibarii*
2. Pod narrowly oblong or oblong-elliptic in outline, either straight or crescentic, becoming laterally or trigonously compressed, distinctly 2- or 3-sided, fully bilocular, the septum broad and conspicuous. Racemes mostly longer and looser and range peripheral to the last, forming an e.-facing crescent with points in s.-w. Utah and s.-centr. Idaho (3)
   3. Pod when ripe, or from the first, laterally compressed and 2-sided, bicarinate by the sutures, never grooved dorsally; s.-w. Utah (Washington and Kane Counties) and adjoining Arizona w. across s. Nevada to s.-e. California.....

.....XL (ii). Subsect. *Ensiformes*

3. Pod when ripe and even at an early stage of formation trigonously compressed, carinate by the ventral suture, grooved dorsally; e.-centr. California to e.-centr. Nevada, s.-e. Oregon and s.-w. Idaho ..... XL (iii). Subsect. *Malaci*

1. Ovary and (dorsiventrally compressed, fully bilocular) pod glabrous, long-stipitate, the stipe 5–12 mm. long. Rare species of the Mohave Desert, California, and of the Snake River canyon along the Idaho-Oregon boundary .....
..... XL (iv). Subsect. *Vallares*

XL (i). Subsectio Cibarii

Stems diffuse or decumbent; *pod* deciduous with the disjointing pedicels, otherwise as kiven in the key.—Sp. 1, distributed as given in the key.

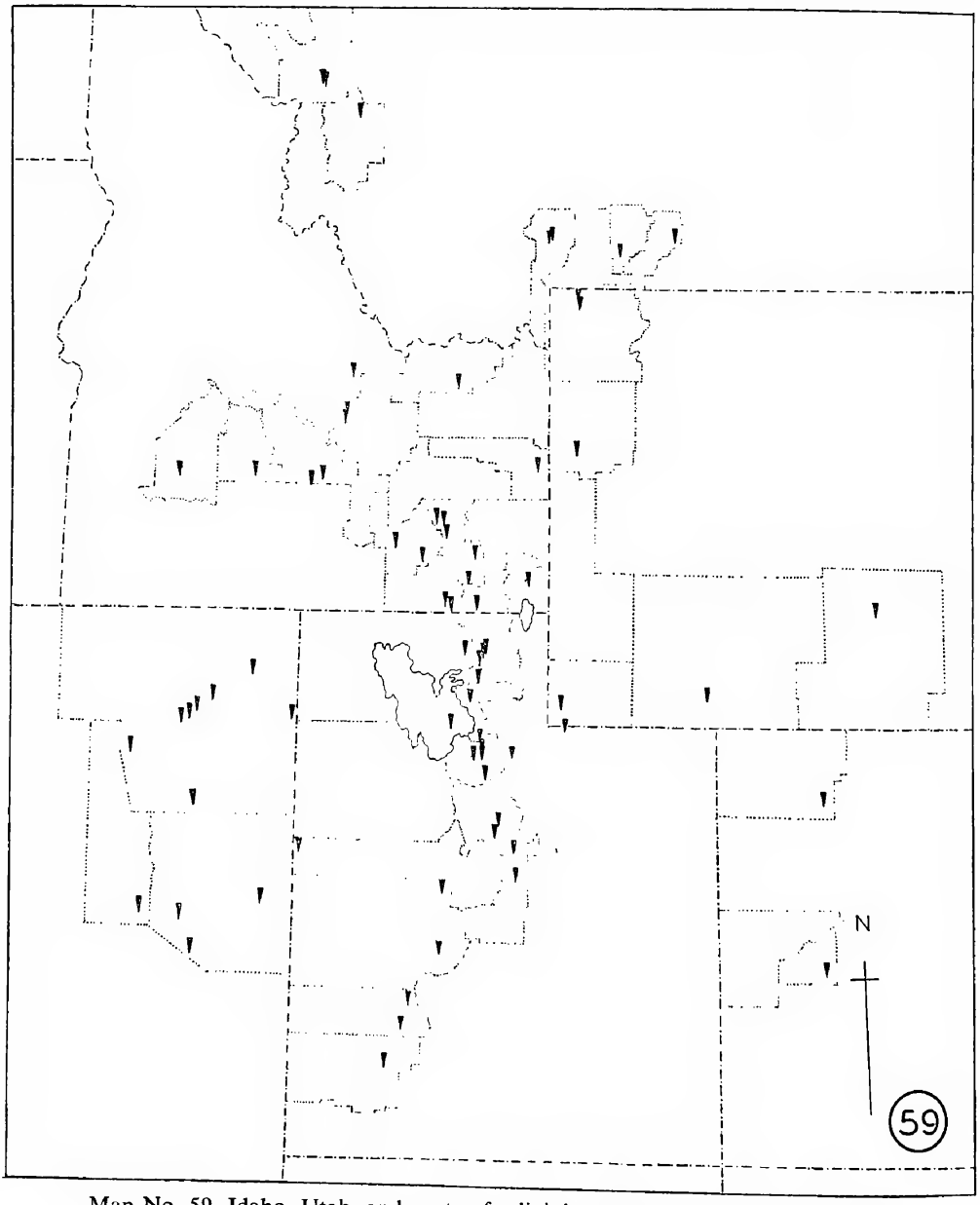
Astragalus sect. Malaci subsect. Cibarii, subsect. nov., inter affines legumine breviter stipitato, obcompresso, uni- vel subuniloculari praestantes.—Sp. unica: *A. cibarius* Sheld.

146. Astragalus cibarius

Of moderate stature, with a shortly forking, ultimately gnarled and woody caudex, strigulose with appressed or subappressed, straight or nearly straight hairs up to 0.5–0.75 mm. long, the herbage greenish or rarely cinereous in youth, the leaflets glabrous above; *stems* several, decumbent or weakly ascending simple, (0.4) 0.6–2 (2.5) dm. long, arising from buds at or just below soil-level; *stipules* 3–8 mm. long, the lowest (or all) membranous, several-nerved, sometimes purplish, ovate, mostly obtuse, large and conspicuous, semidecurrent-amplexicaul, the upper ones progressively narrower, the uppermost deltoid or lanceolate, acute; *leaves* 3.5–10 cm. long, all petioled but the upper ones shortly so, with (9) 13–19 obovate, oblong-obovate, or broadly oblanceolate, obtuse or commonly retuse-emarginate, mostly flat leaflets 4–17 mm. long; *peduncles* 3–8 cm. long, incurved-ascending at anthesis, reclinate in fruit; *racemes* loosely but shortly 4–14-flowered, subcapitate in early anthesis, the flowers spreading-ascending, the axis little elongating, 0.5–1.5 cm. long in fruit; *bracts* membranous, ovate or lance-acuminate, 2–4 mm. long; *pedicels* ascending, at anthesis 1–1.6 mm. long, in fruit thickened, 2–2.5 mm. long, finally disjointing and falling with the marcescent calyx and pod; *bracteoles* 0–2; *calyx* 6.4–8.6 mm. long, densely strigulose with black or largely black hairs, the disc 0.8–1.3 mm. deep, the campanulate or subcylindric tube 5–6.5 mm. long, 2.4–3.8 mm. in diameter, the subulate teeth 1.4–2.5 mm. long, the ventral pair commonly shortest and broadest; *petals* ochroleucous tinged with dull lavender, pale bluish-white, or occasionally purple with white wing-tips; *banner* recurved through about 45°, 15–19 mm. long, the cuneate claw expanded into a rhombic-ovate blade 8–10 mm. wide; *wings* 13.4–17 mm. long, the claws 5.4–7 mm., the narrowly oblong, obtuse, nearly straight blades 9–11.2 mm. long, 2.2–2.7 (3.3) mm. wide; *keel* 9.8–12.7 mm. long, the claws 5.2–6.8 mm., the half-obovate blades 5.3–6.7 mm. long, 2.7–3.2 mm. wide, incurved through 75–90° to the rounded apex; *anthers* 0.55–0.7 mm. long; *pod* loosely ascending (humistrate), subsessile or cuneately narrowed at base into a thick, necklike stipe up to 2 mm. long, the ellipsoid or oblong-ellipsoid body 1.7–3.2 cm. long, 7–9 (10) mm. in diameter, nearly straight or incurved through one third circle (the curvature usually more abrupt in the lower than the distal half), contracted distally into a short, laterally compressed, deltoid beak, otherwise obcompressed (caveat lector: often distorted by pressing), when relatively long openly sulcate both dorsally and ventrally, when short only a little sulcate ventrally near the base and flattened or low-convex dorsally, both sutures thick and prominent but the dorsal one less so and commonly undulate, the fleshy, green, minutely strigulose valves becoming stramineous, woody or stiffly leathery, rugulose-reticulate, not inflexed, or inflexed as a narrow partition less than 1 mm. wide; *ovules* 27–32; *seeds* dark brown pitted or

nearly smooth, 2.5–3.3 mm. long.—Collections: 76 (x) representative: *J. H. & C. B. Christ 19,933* (ID, NY, WS); *Hitchcock & Muhlick 8833* (CAS, NY, RSA, WS); *Lingenfelter 526* (CAS, NY, RSA, SMU, WS); *C. L. Porter 4154* (RSA, SMU, TEX); *Ripley & Barneby 6456* (NY, RSA); *Kirkwood 2063* (CAS, NY, OB); *W. A. Weber 7338* (RSA).

Grassy hillsides, sagebrush flats, valley floors, and canyon benches, in stiff clay or gravel, but without apparent rock preference, (3300, northward) 4900–8000 feet, common and locally plentiful in southeastern Idaho and northern Utah, extending less abundantly north to Clarks Fork in Missoula County and to the Gallatin and Yellowstone Valleys in Gallatin, Sweet Grass, and Stillwater Counties, Montana, thence southeast to the upper North Platte in Carbon County, Wyoming,



Map No. 59. Idaho, Utah, and parts of adjoining states. Range of *A. cibarius*.

and to the Yampa and North Gunnison Rivers in Moffat and Delta Counties, Colorado, west into the calcareous ranges of northeastern and eastcentral Nevada, and south along the Wasatch in Utah to Iron County.—Map No. 59.—April to early August.

ASTRAGALUS CIBARIUS (suitable for fodder) Sheld. in Minn. Bot. Stud. 1: 149. 1894.—"Collected in Utah Valley, Utah, May, 1880, by M. E. Jones; also west side of Johnston Pass, south fork of Humboldt river and Great Desert, Utah, May, 1859, by Henry Engelmann, and in gravelly bottoms, Gros Ventres fork and Jackson's Hole, Wyoming, June, 1860, by F. V. Hayden."—Lectotypus, *Jones 1679,* collected May 3, 1880, MINN! isotypi, GH, NY, POM! Paratypi (*Engelmann,* from Johnston's Pass and s. fork of the Humboldt, doubtless in Nevada, in 1859), MO! The Hayden collections from Wyoming (MO) both represent *A. terminalis.—A. Webberi* var. *cibarius* (Sheld.) Jones, Contrib. West. Bot. 10: 87. 1902. *Xylophacos cibarius* (Sheld.) Rydb. in Bull. Torr. Club 40: 48. 1913.

Astragalus cuspidocarpus (with pointed pod) Sheld. in op. cit. 147. 1894.—"Collected near Grafton, Montana, June, 1892, R. S. Williams; also on dry rocky ground near Mammoth Hot Springs, Yellowstone National Park, Wyoming, May and June, by Mr. F. H. Burglehaus." —Holotypus, the first cited, labeled "type-specimen" in Sheldon's hand, MINN!—*A. thermalis* (of hot springs) Greene in Erythea 3: 76. 1895, a deliberate, pedantic substitute. *A. lentiginosus* var. *cuspidocarpus* (Sheld.) Jones in Proc. Calif. Acad. Sci. II, 5: 673. 1895 (quoad nom., exclus. spm. cit.—cf. Barneby, 1945, pp. 106, 141). *Xylophacos cuspidocarpus* (Sheld.) Rydb. in Bull. Torr. Club 40: 48. 1913. *A. missouriensis* var. *cuspidocarpus* (Sheld.) Jones, Rev. Astrag. 213. 1923.

Astragalus arietinus (resembling a ram's head, from the divergently recurving valves of the dehiscent pod, a character mistakenly derived, acc. Jones, 1923, p. 203, from *A. iodanthus*) Jones in Proc. Calif. Acad. Sci. II, 5: 653. 1895.—"No. 5554o. June 30, 1894, Fairview, Utah . . . No. 5208a. May 11, 1894, Cedar City, Utah . . ."—Holotypus, *Jones 5554o,* POM! paratypus *(Jones 5208a)* POM!

The browse milk-vetch, *A. cibarius,* is a superficially commonplace species of undistinguished mien, resembling in habit several of the larger-flowered forms of *A. lentiginosus,* to which flowering specimens are often referred in herbaria. The large, veiny lower stipules usually provide a clue to the identity of even quite young material. The pod resembles in exterior form that of several *Argophylli,* but it is either stipitate or at least contracted at base into a thickened neck continuous with the receptacle and therefore falls together with the disjointing pedicel. It varies greatly in length and simultaneously in the degree of dorsiventral flattening. A fruit of relatively short and plump outline is commonly rounded on the dorsal face and ventrally sulcate near the base, whereas the longest pods are commonly grooved along both sutures from the beak downward. Intergradation between the extreme forms and sizes of the pod is gradual and completely documented by specimens, and variation even in small colonies of otherwise like plants is often considerable. Although much of the material examined from Wyoming and Montana has fruits of the smaller type, a long pod is characteristic of the known populations in Missoula County, a short pod appears sporadically in central Utah, and it is impossible to regard the northern form, maintained by Rydberg as *Xylophacos cuspidocarpus,* as anything but a minor variant.

The species was collected first in 1844 by Fremont, but the locality was not recorded. It was next seen by Stansbury in 1850 near Great Salt Lake, and again along the Emigrant Trail in 1859 by Dr. Engelmann. In 1869 Watson found it in the Wasatch foothills near Salt Lake City and on Antelope Island in the lake, but since he misinterpreted (1871, p. 71) his material as a form of *A. iodanthus, A. cibarius* remained undescribed until 1894. Watson's assumption that *A. cibarius* and *A. iodanthus* are close relatives has led many students of *Astragalus* astray, and the error continues to echo in the literature up to the present day. The epithet *arietinus* which Jones applied to *A. cibarius* was in reality descriptive of *A. iodanthus,* in which the pod splits downward through the beak and the valves coil outward in a manner suggesting a pair of ram's horns. The differential characters of the two species are mentioned at greater length under *A. iodanthus.*

XL (ii). Subsectio ENSIFORMES

Stems erect or incurved-ascending; otherwise as described in the subsectional key.—Spp. 3, of eastcentral and southern Nevada, southwestern Utah, extreme northwestern Arizona, and the Mohave Desert and Death Valley region in southeastern California.

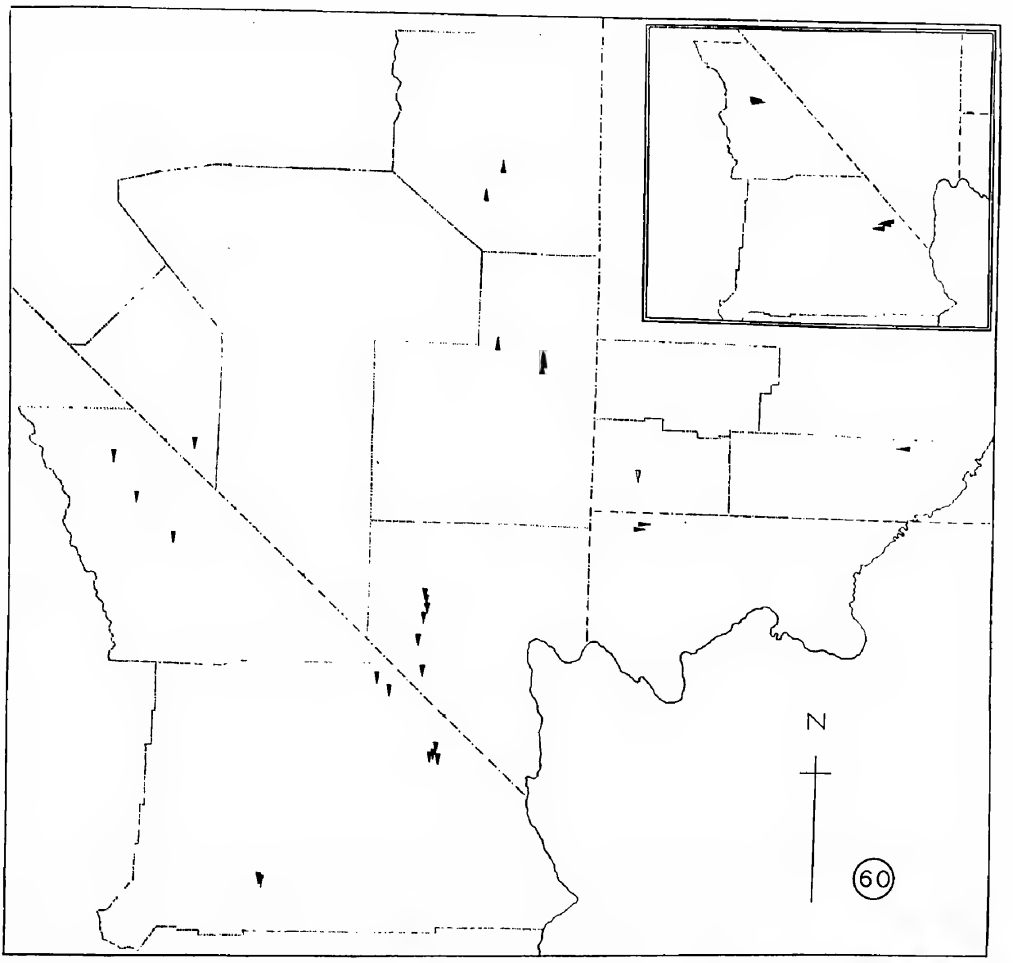
ASTRAGALUS sect. MALACI subsect. ENSIFORMES, subsect. nov., inter affines legumine anguste oblongo, breviter stipitato vel subsessili, primum tereti maturo (rarius jam juvenili) de latere ± compresso suturis prominulis bicarinato, prorsus biloculari insignes.—Sp. typica: *A. ensiformis* Jones.

Key to the Species of Subsect. Ensiformes

1. Flowers relatively small, the calyx 6–8 mm. with teeth less than 3 mm. long, the banner 12–17 mm., the keel 9.5–13 mm. long; *pod* nearly terete when first formed, becoming compressed in ripening, either strigulose, or if villous-hirsute then erect from erect peduncles; s.-w. corner of Utah and adjoining Arizona w.-ward (2)
   2. Stems weakly ascending from a shallowly buried root-crown; *peduncles* incurved-ascending, weighed down by the essentially pendulous fruits, the flowers early declined and secund; *pod* deciduous with the disjointing pedicel; n.-w. Arizona ..... 147. *A. ensiformis*
   2. Stems stiffly erect and ascending from a usually superficial root-crown or caudex; *peduncles* erect, the flowers and fruits permanently erect or ascending; *pod* dehiscent on the raceme; extreme s.-w. Utah to e.-centr. Nevada and s.-e. California ..... 149. *A. Minthorniae*
1. Flowers larger, the calyx ± 14–15.5 mm. with teeth ± 5–6 mm. long, the banner 20–21.5 mm., the keel 16–17 mm. long; *pod* compressed and 2-sided from the first; Kaiparowits Plateau in Kane County, Utah. Stems short, from a shallowly buried root-crown; *flowers* at length declined; *pod* (crescentically incurved, hirsutulous) humistrate ..... 148. *A. malacoides*

147. ASTRAGALUS ENSIFORMIS

Low but rather coarse, with shallowly buried root-crown or caudex, strigulose with fine, tapering, straight, appressed hairs up to 0.4–0.8 mm. long, the growing tips cinereous, the leaflets bicolored, yellowish-green and glabrescent above, the inflorescence loosely black-pubescent; *stems* several, simple, 8–13 cm. long, composed of several short, subterranean internodes as long or only 2–3 times longer than the stipules, and 4–5 developed internodes 2–6 cm. long, floriferous from the 2–3 uppermost leaf-axils; *stipules* dimorphic, the lowest papery, pallid, broadly ovate, obtuse, several-nerved, 4–10 mm. long, amplexicaul-decurrent but free, broader than the stem, the upper ones progressively narrower, subherbaceous, the uppermost lanceolate or narrowly ovate, acute; *leaves* 5–13 cm. long, petioled but the uppermost shortly so, with 13–17 ovate, obovate, or oblong-obovate, obtuse or retuse, flat, thick-textured leaflets 8–20 mm. long; *peduncles* at first incurved-ascending, in fruit subhorizontal, 5–12 cm. long; *racemes* loosely 12–30-flowered, the axis 4–10 cm. long in fruit; *bracts* submembranous, lanceolate, 2.5–5 mm. long; *pedicels* at anthesis 1–1.5 mm. long, early arched outward, in fruit 1.5–3 mm. long; *bracteoles* 0; *calyx* 7.3–7.7 mm. long, densely black-pilosulous, the disc 0.5–0.6 mm. deep, the membranous, purplish, cylindric tube oblique at base, 6–6.5 mm. long, 2.8–3 mm. in diameter, the subulate teeth 1.2–1.5 mm. long, the ventral pair broadest and shortest; *petals* sordid purple, the wing-tips paler or whitish; *banner* recurved through about 45°, rhombic-ovate beyond the cuneate claw, 14–15 mm. long, 7–8.6 mm. wide; *wings* 12.2–14 mm. long, the claws 6–6.4 mm., the narrowly oblong-oblanceolate, obtuse, nearly straight blades 7.2–8.5 mm. long, 1.8–2 mm. wide; *keel* 10.5–10.8 mm. long, the claws 5.9–6.2 mm., the half-obovate blades 5.2–5.3 mm. long, 2.5–2.6 mm. wide, incurved through 80–90° to the blunt apex; *anthers* 0.6–0.65 mm. long; *pod* essentially pendulous but sometimes ascending when humistrate, shortly and obscurely stipitate, the thick stipe about 1 mm. long, concealed by the marcescent calyx, the body narrowly oblong in profile, incurved through about ½-circle, 2.5–3 cm. long, 5–6 mm. in diameter, fleshy, solid and subterete when first formed, in ripening becoming strongly compressed laterally, bicarinate by the prominent cordlike sutures, the faces low-convex, the thick, green but red-tinged,



Map No. 60. Southern Nevada and parts of adjoining states. Range of *A. Minthorniae*: ◢ var. *Minthorniae*; ◡ var. *gracilior*; and ◢ var. *villosus*; of ◗ *A. ensiformis*; and of ◖ *A. malacoides*. Inset (top right), the Mohave Desert, California. Range of *A. cimae*: ◖ var. *cimae*; and ◗ var. *sufflatus*.

strigulose valves becoming leathery, brownish, rugulose-reticulate, inflexed below the short, cuspidate, unilocular beak as a complete septum; *dehiscence* apical, tardy, after falling; *ovules* 32–36; *seeds* about 3 mm. long, not seen fully ripe.—Collections: 2 (i); representative: *Ripley & Barneby 4311* (CAS, K, RSA).

Gullied hillsides, in red clay and limestone gravel, preferring northern exposures in piñon-juniper forest, 5000–5500 feet, very local but forming colonies, known only from the Virgin-Colorado divide in the region of Mokiak Pass, northern Mohave County, Arizona.—Map. No. 60.—April to May.

ASTRAGALUS ENSIFORMIS (sword-shaped, of the laterally compressed pod, but inappropriate) Jones, Rev. Astrag. 226, Pl. 56. 1923, based on *A. ursinus* sensu Jones in Proc. Calif. Acad. Sci. II, 7: 657. 1895 (non Gray).—"No. 5095ah. April 23, 1894, top of grade, four miles above Pagumpa, Arizona . . ."—Holotypus, POM!—*Hamosa ensiformis* (Jones) Rydb. in Bull Torr. Club 54: 21. 1927. *A. ensiformis* var. *typicus* Barneby in Proc. Calif. Acad. Sci. IV, 25: 157. 1944.

The close resemblance of the Pagumpa milk-vetch, *A. ensiformis*, to *A. cibarius*, emphasized by Jones in the places cited in the synonymy above, is no doubt more than coincidental and indicates a very real relationship which emphasis on the greatly dissimilar pods has

obscured. Despite the similarity in habit, *A. ensiformis* may be recognized even in flower by its ascending rather than diffuse stems and by the looser racemes of 15–25 (not 4–14) slightly smaller flowers. The discovery of *A. Minthorniae* var. *gracilior,* which I subordinated at first to *A. ensiformis,* provided the clue to an even closer affinity in another, unexpected direction. The var. *gracilior* may be described loosely as combining the vesture of *A. ensiformis* with the growth-habit of *A. Minthorniae.* Shorn of the variety, *A. ensiformis* differs from the now relatively polymorphic *A. Minthorniae* in its shorter, weakly ascending stems, incurved and finally divergent or humistrate peduncles, and especially in the pendulous fruits which finally fall away with the disjointing pedicels. The pod of the Pagumpa milk-vetch is thickly fleshy when first fully formed, and its pendulous attitude is perhaps due more to the weight of the watery tissues than to any purposeful torsion of the pedicel supporting it. Since the gently incurved, blunt-edged fruits are not at all swordlike, the epithet *ensiformis* is poorly chosen. When fresh they are fleshy, with green pulp and reddish skin, resembling small, curved sausages hung out in a secund row along the axis of the raceme.

148. Astragalus malacoides

Low, diffuse, with a woody taproot and shallowly buried, shortly forking caudex, the stem, leaves, and pods hirsutulous with rather stiff, horizontally spreading or somewhat incurved hairs up to 0.35–0.5 mm. long, the inflorescence beset with some longer, weaker, black or fuscous hairs up to 0.7 mm. long, the purplish stems and young herbage cinereous, the leaflets bicolored, yellowish-green and glabrous above; *stems* few, decumbent, up to 0.8–12 cm. long, pallid and subterranean for a space of 1–5 cm., simple beyond the immediate base, inhibited beyond the first or second stout, subterminal peduncle; *stipules* 2–7 long, dimorphic, those at the lowest, short and congested nodes broadly obovate or flabellate, obtuse, many-nerved, early becoming papery and glabrous except at very base, strongly adnate to the suppressed petiole and almost fully amplexicaul, the upper ones broadly lanceolate or ovate, greenish-purple, submembranous, pubescent dorsally; *leaves* 4.5–14 cm. long, shortly petioled, with 15–29 broadly obovate-cuneate to suborbicular or broadly oblong-elliptic, very obtuse to emarginate, flat or loosely folded leaflets 7–18 mm. long; *peduncles* incurved-ascending at anthesis, procumbent in fruit, 5–9 cm. long; *racemes* loosely 10–15-flowered, the flowers at first ascending, spreading or declined in age, the axis somewhat elongating, up to 3–9.5 cm. long in fruit; *bracts* linear-lanceolate, submembranous, pallid or purplish, 3–5 mm. long; *pedicels* at anthesis 1–1.5 mm. long, in fruit recurved, thickened, 1.5–2.5 mm. long; *bracteoles* 2, vestigial or up to 2.5 mm. long; *calyx* 14–15.6 mm. long, the oblique disc 1.6–2.1 mm. deep, the membranous, purplish, thinly hirsutulous tube 9.8–10.8 mm. long, 3.7–4.2 mm. in diameter, the narrowly lance-acuminate, somewhat falcately incurved teeth 4.8–6 mm. long, the whole becoming papery, ruptured, marcescent; *petals* purplish, apparently not brightly colored; *banner* recurved through ± 40°, rhombic-oblanceolate, notched, 20–21.6 mm. long, 7.5–9.7 mm. wide; *wings* 18.4–18.7 mm. long, the claws 9.5–9.7 mm., the narrowly oblanceolate, obtuse, scarcely incurved blades 9.5–10 mm. long, 2.2–3 mm. wide; *keel* 16–17 mm. long, the claws 9.4–9.7 mm., the lunately oblanceolate blades 7.5–8 mm. long, 2.7–3.1 mm. wide, gently incurved through 85° to the rounded apex; *anthers* 0.65–0.9 mm. long; *pod* declined or (when humistrate) apparently ascending, shortly stipitate, the stout, straight stipe 2.5–3 mm. long, the body narrowly oblong-elliptic in profile, incurved through ¼–⅓-circle, 3.5–4 cm. long, 5–6 mm. in diameter, cuneately contracted at base into the stipe and distally into a stout cusp, strongly compressed laterally, carinate by the stout ventral and more slender dorsal sutures, the faces low-convex, the scarcely fleshy, at length papery, brownish but minutely purple-dotted valves hirsutulous with widely ascending hairs up to 0.3–0.5 mm. long, inflexed as a complete septum; *ovules* 24–28; *dehiscence* (presumably apical, after falling) and seeds unknown.—Collections: 2 (i, fragmentary).

On clay-loam ridges and steep barren slopes in and below the juniper-piñon forest, 4500–6000 feet, known only from the northeast slope of Kaiparowits Plateau near Willow Tank, ± 43 miles southeast of Esclante, in eastern Kane County, Utah.—Map No. 60.—Late April and May.

ASTRAGALUS MALACOIDES (simulating *A. malacus*), sp. nov., *A. ensiformi* Jones manifeste affinis, sed pube hirsutula nec appressa, calycis subduplo longioris dentibus elongatis, petalis multo longioribus, necnon legumine vix carnosulo jam juvenili compresso maturo chartaceo nec coriaceo longiori valde diversa.—Habitus, racemus subbrevis et legumen crescentiforme *A. chamaemeniscum,* pubes patula atque calyx subtumidus longidentatus *A. malacum* referrunt, sed ob legumen bi- nec tricarinatum melius inter *Ensiformes* quam *Malacos* genuinos ponetur species.—UTAH: n.-e. slope of Kaiparowits Plateau, s. of Willow Tank, Kane County, May 9, 1939, *B. F. Harrison No. 9069.*—Holotypus, US! isotypi, BRY, NY (fragm.).

The Kaiparowits milk-vetch, *A. malacoides,* combines features of three related species. The habit of growth is that of *A. chamaemeniscus*: a few short, weak stems arising from a shallowly buried root-crown and bearing one or two subterminal racemes of relatively few, loosely but shortly racemose flowers from which develop large crescentic pods, these essentially pendulous but humistrate, and thus falling at random angles on the ground. The vesture of the stems, leaves, and pods, although shorter and composed entirely of filiform hairs not thickened at the base, is of the widely spreading and rather coarse type found in *A. malacus;* moreover, *A. malacoides* also has nearly the flower and characteristically long-toothed calyx of the latter species. The two-sided, fully bilocular pod, however, is carinate by both sutures, not triquetrous and grooved dorsally as in subsect. *Malaci.* It can be compared only with that of *A. ensiformis* at the fully ripe stage, when the fleshy valves have dried out and collapsed inward, exposing the sutural keels. Unlike that of *A. ensiformis,* which is terete and succulent when first formed, the pod of *A. malacoides* apparently assumes its lateral compression as the ovary expands, and the valves are only a trifle fleshy, soon becoming chartaceous and reticulate. In the meager material of these two rare species now available, the pod of *A. malacoides* is longer and more strongly incurved, but these features may prove variable. In any event the Kaiparowits milk-vetch is easily distinguished by its hirsutulous pubescence, much larger flowers, and elongate calyx-teeth. It seems quite likely that the range of *A. malacoides* is as limited in extent as that of *A. ensiformis,* which occupies a similar ecological niche on the limestones of the Virgin-Colorado divide in northwestern Arizona. Both are conspicuous plants which could hardly go long undetected, if they were at all widely dispersed.

149. ASTRAGALUS MINTHORNIAE

Caulescent perennials with erect or stiffly ascending stems, variably pubescent with appressed or widely spreading hairs, the herbage green or canescent, the leaflets commonly bicolored, brighter green and occasionally glabrescent above, the inflorescence black- or partly black-pilosulous; *stems* few or several, simple, (0.3) 1–3 dm. long, composed of short lower internodes often concealed by stipules and (2) 3–5 developed ones (1) 3–7 (10) cm. long, *stipules* somewhat dimorphic, the lowest papery-membranous, ovate and mostly obtuse, 4–15 mm. long, adnate to a suppressed petiole and ± strongly amplexicaul-decurrent but free, the pairs together forming a loose sheath often broader than the stem, the upper ones progressively narrower, the uppermost subherbaceous, deltoid to lanceolate, mostly acute; *leaves* (4) 6–17 cm. long, all petioled, with (7) 9–17 obovate-cuneate, ovate, or suborbicular, obtuse or emarginate, rarely elliptic and acute, flat leaflets 8–20 (26) mm. long; *peduncles* erect, at least the earliest one stout, 6–16 cm. long; *racemes* loosely 7–35-flowered, oblong in early anthesis, the axis elongating, 2.5–12 (25) cm. long in fruit; *bracts* membranous, lanceolate, 2–6 mm. long; *pedicels* at anthesis about 1 mm. long, in fruit thickened, persistent, 2–3.5 mm. long; *bracteoles* 0–2; *calyx* 6–7.8 mm. long, thinly or densely pilosulous with mostly black hairs, the disc 0.4–0.8 (1.2) mm. deep, the deeply campanulate or cylindric tube 4.5–5.2 mm. long, 2–2.8 (3.2) mm. in diameter, the subulate teeth 1.5–2.7 mm. long, the ventral pair often broadest and sometimes shortest; *petals* ochroleucous tinged with dull purple, or luridly

vinous-purple with pallid or white wing-tips; *banner* recurved through ± 45°, 12–17 mm. long, the long-cuneate claw expanded into a rhombic-ovate blade (5) 6.5–9 mm. wide; *wings* 11–15 mm. long, the claws 4.8–6 mm., the narrowly oblong, nearly straight, obtuse or erose-emarginate blades (6.3) 7–9.8 mm. long, 1.8–2.7 mm. wide; *keel* 9.5–13 mm. long, the claws 4.8–7 mm., the half-obovate blades 4.5–7.5 mm. long, 2.5–3.2 mm. wide, incurved through 70–80° to the rounded apex; *anthers* (0.55) 0.6–0.7 mm. long; *pod* erect or ascending at a narrow angle, subsessile or shortly stipitate, the stout necklike stipe 0.5–1.5 mm. long, the body narrowly oblong-elliptic to linear-oblong or narrowly oblanceolate in profile, straight or gently incurved, 1.5–3 cm. long, 4–6 mm. in diameter, cuneate or rounded at base, abruptly acute and cuspidate at apex, subterete or a trifle laterally compressed when first formed, becoming decidedly compressed in ripening, but the faces remaining convexly rounded as the ventral suture becomes prominent and cordlike, the somewhat fleshy valves becoming leathery, transversely reticulate beneath the vesture, pilosulous or shaggy-villous, inflexed as a complete septum; *dehiscence* apical and downward about half-way through the ventral suture, the walls of the septum partially separating in age; *ovules* 22–34; *seeds* brown or ochraceous, pitted and angled, 2.3–3.4 mm. long.

Key to the Varieties of A. Minthorniae

1. Stems and herbage strigulose, the hairs truly appressed or subappressed, the longest up to about 0.7 (1) mm. long; *basal internodes* and stipules sparingly pubescent, at least not conspicuously more densely than the stem distally; e. Nevada and s.-w. Utah (2)
   2. Pod linear-oblong or -oblanceolate in profile, incurved through nearly ¼-circle, 2–3 cm. long, 4–5 mm. in diameter; *seeds* 2.7–3.4 mm. long; s.-w. Utah ..... 149a. var. *gracilior*
   2. Pod narrowly or broadly oblong in profile, straight or nearly so, 1.5–2.7 cm. long, 5–6 mm. in diameter; *seeds* 2.3–2.7 mm. long; e. Nevada.....149b. var. *Minthorniae*
1. Stems and herbage villous with spreading, sometimes curly hairs up to 0.8–1.5 mm. long; *basal internodes* and stipules densely and canescently villous-pilose, generally more densely so than the stems distally; Mohave Desert and Death Valley region, s.-e. California and adjoining Nevada ..... 149c. var. *villosus*

149a. Astragalus Minthorniae var. gracilior

Slender, the stems purplish; *caudex* sometimes shallowly buried; *vesture* sparse, appressed; *petals* ochroleucous tinged with dull lavender-purple; *pod* shortly pilosulous with white hairs up to 0.5–0.7 mm. long.—Collection: 1 (typus).

Open valley floor, in stiff clay soil, the plants sheltering under and growing up through sagebrush, about 4900 feet, known only from the western foothills of the Pine Valley Mountains, Washington County, Utah.—Map No. 60.—April to May.

Astragalus Minthorniae var. gracilior (Barneby) Barneby in Amer. Midl. Nat. 55: 493. 1956, based on *A. ensiformis* var. *gracilior* (more slender, as compared with genuine *A. ensiformis*) Barneby in Proc. Calif. Acad. Sci. IV, 25: 158, Pl. 17, fig. 28. 1944—"Utah: ... 5 miles south of Veyo, Washington Co.... *Ripley & Barneby 4951.*"—Holotypus, CAS! isotypi, K, NY, RSA!

By listing var. *gracilior* first in order of precedence, I run the risk of overemphasizing its biological importance in the context of its species. It is a rare and highly localized form, as likely as not a recent derivative from var. *Minthorniae*, which occurs only a short distance westward across the Nevada line. It is of interest principally because of its similarity and apparently close affinity to the preceding species, *A. ensiformis*, of which the two known stations lie close together some twenty-five miles southward. At the time I described var. *gracilior* as a variety of *A. ensiformis*, the distinctions between genuine *A. Minthorniae* and its var. *villosus* had not been worked out, and I compared it only with the latter, which seemed adequately differentiated by its straight, shaggy-villous pod. The var. *gracilior* simulates some particular populations of var. *Minthorniae* to a degree which leaves no choice but to unite

them under the same specific heading. The relatively long and narrow, evenly incurved, and shortly pilosulous rather than villous pod and the larger seeds provide the best characters. The shallowly buried root-crown of var. *gracilior* is suggestive of *A. ensiformis,* but the stiffly erect stems and peduncles and the erect, persistent fruits lean much more heavily toward var. *Minthorniae.* Possibly it represents a step in the evolutionary path which has culminated in *A. ensiformis* and *A. malacoides.*

A rather tall, slender astragalus, var. *gracilior* presents an undistinguished appearance, the dull lavender flowers being small in proportion to the ample foliage, and the pod having lost the silken fleece which makes other forms of *A. Minthorniae* so ornamental in fruit. In the type-locality it was most difficult to see the plants, all of them growing up through clumps of sagebrush, by which all but the tops of the racemes were concealed.

149b. Astragalus Minthorniae var. Minthorniae

Root-crown or caudex superficial; *vesture* variable in density, the herbage greenish or cinereous; *petals* ochroleucous, the keel tipped with dull purple, the banner sometimes suffused with sordid lavender; *pod* 1.5–2.7 cm. long, straight or nearly so, silky-pilose with white or largely white hairs.—Collections: 6 (ii); representative: *Train 2642* (NA, TEX); *Eastwood & Howell 9371* (CAS); *Ripley & Barneby 6300* (RSA).

Dry stony hillsides, in open places among low sagebrush, often in juniper-piñon forest, 6000–7100 feet, mostly on limestone, not common, upper Muddy River Valley, Lincoln County, north to the Egan Range in southwestern White Pine County, Nevada,—Map No. 60—Late April to early June.

Astragalus Minthorniae (Rydb.) Jeps., Fl. Calif. 2: 374. 1936 (quoad nom.), based on *Hamosa Minthorniae* (Maud Minthorn, —) Rydb. in Bull. Torr. Club 54: 15. 1927.—"Nevada: vicinity of Pioche, Lincoln County, April 24, 1909, *Maud Minthorn 77* . . ." —Holotypus, NY! isotypus, UC!

The typical phase of the Minthorn milk-vetch is notable for the contrast between the appressed vesture of the greenish or greenish-cinereous foliage and the loose pubescence of the raceme, ordinarily black-pilosulous on the bracts and calyces and white-silky on the pods. I have been able to learn nothing about the original collector, except that she was active botanically in Lincoln County, Nevada, about 1909; her plants are at NY and UC. Her name belongs with those of Fannie Fish, Georgia H. Bentley, and the Miss Searls of *Petalostemon Searlsiae,* whose "sense and spirit," shown in collecting plants in remote and inhospitable desert places, was so highly praised by Asa Gray.

149c. Astragalus Minthorniae var. villosus

Caudex superficial; *stature* variable, the stems either slender and with only 2 developed internodes, or coarse and robust, up to 3.5 dm. long; *herbage* and stems villosulous, the lowest, sheathing stipules pilose-canescent; *petals* either ochroleucous with maculate keel-tip, or pink-purple with pale or white wing-tips; *pod* almost as in var. *Minthorniae,* but often more densely shaggy-villous with white or partly black hairs 0.6–1.3 mm. long.—Collections: 23 (vii); representative: *Purpus 5939* (UC); *Clokey 7575* (Pl. Exsicc. Gray. *724*); *C. B. Wolf 3280* (CAS, TEX, WS), *10,458* (CAS, NY); *Munz 13,711* (POM, WS); *S. B. & W. F. Parish 1275* (DS, WS).

Rocky hillsides, gravelly benches, and canyon washes, sometimes among sagebrush on valley floors, usually in juniper-piñon forest, strongly and perhaps obligately calciphile, 4400–7800 feet, common and locally plentiful in the foothills of the Spring and Charleston Mountains of southern Clark County, Nevada, and of the New York, Clark and Kingston Ranges of adjoining San Bernardino County, California, extending north, apparently disjunctly, to the Inyo Mountains, Inyo County, and to Gold Mountain across the Nevada line; also quite isolated on the calcareous enclave of Cushenbury Canyon in the San Bernardino Mountains, southwestern San Bernardino County.—Map No. 60.—Late March to June.

ASTRAGALUS MINTHORNIAE var. VILLOSUS (loosely hairy) Barneby in El Aliso 2: 208. 1950. —"CALIFORNIA: Inyo Mountains 12 miles east of Zurich, Inyo Co., alt. 7200 ft., 18 May, 1944, *Ripley & Barneby 4951.*"—Holotypus, CAS! isotypi, GH, NY, RSA!

The villous variety of the Minthorn milk-vetch varies greatly in stature, probably in response to seasonal fluctuation in rainfall. The stems of the dwarf state consist of several inhibited lower internodes concealed by densely hairy stipules and sometimes no more than two developed ones; in such individuals the peduncles appear subscapose and the plant's whole habit of growth is comparable to that of the *Conjuncti* and several *Reventi-Arrecti.* More often, however, several internodes are produced and the peduncles become obviously lateral and cauline. The shaggy vesture of the erect, oblong-cylindric pod is ordinarily composed of long, silvery hairs mixed with shorter, black ones, but the latter are sometimes few or lacking.

The var. *villosus* was first collected in 1882, by the Parish brothers, in its isolated station in Cushenbury Canyon, and again before the turn of the century by Purpus in Nevada. Jones must have seen both these collections, as well as several later ones, misinterpreting them as a form of *A. malacus* or as an imaginary hybrid between *A. malacus* and *A. Layneae.* A specimen of var. *villosus* collected by the Brandegees at Good Springs, Nevada (UC) is labeled by Jones *"A. Layneae* intergradient to *A. malacus,"* although this is not the original *A. malacus* × *Layneae* which came from Inyo County (cf. discussion of *A. Layneae*). The Minthorn milk-vetch in all its forms is easily distinguished from *A. Layneae* by its determinate (never stoloniferous), commonly superficial root-crown and by its erect, persistent, shorter, laterally and not dorsiventrally compressed legume.

The established range of var. *villosus* lies well to the west and south of that of var. *Minthorniae,* but the gap between them as shown on the map is possibly less real than apparent. The territory lying between the Charleston massif and the headwaters of the Muddy River in southern Nevada has always been difficult of access and is still poorly known botanically.

XL (iii). Subsectio VALLARES

Stems diffuse and decumbent; *caudex* superficial or nearly so; *herbage* subglabrous; *pod* as described in the key to subsections, falling with the disjointing pedicel, commonly fleshy, solid, drying stiffly leathery or subligneous, the body in 1 form inflated and papery.—Spp. 2, both of greatly restricted range, 1 of the Mohave Desert, southeastern California, 1 of the Snake River canyon along the Oregon-Idaho boundary.

ASTRAGALUS sect. MALACI subsect. VALLARES (Jones), stat. nov., based on *Astragalus* sect. *Reventi-Arrecti* subsect. *Vallares* Jones, Rev. Astrag. 159, in clave. 1923.—Sp. typica: *A. vallaris* Jones.

The two rare species convened into subsect. *Vallares* are apparently highly modified and probably not very closely related, but they possess so many important morphological features in common that they must inevitably be associated in any systematic account. This was recognized by Jones (1923, p. 163) who placed them side by side, with *A. Bolanderi,* among several heterogeneous elements appended to his loosely defined sect. *Reventi-Arrecti.* They were injudiciously dispersed by Rydberg (1929) among widely separated genera, *A. cimae* being transferred to *Phacomene* next to *A. Beckwithii* (in which the apparent stipe is in reality a gynophore) and *A. vallaris* to *Hesperonix,* a group now restricted to *A. Bolanderi,* which has connate stipules. Collectively the two species resemble *A. cibarius* in most diagnostic features, differing principally in the better-developed stipe and septum of the pod.

Key to the Species of Subsect. Vallares

1. Herbage green; *racemes* 5–7-flowered, the axis 1.5–2 cm. long in fruit; *calyx* nearly 1 cm. long, its teeth over 3 mm. long; petals whitish, the banner ± 19 mm. long; Snake River Canyon, e. Oregon and adjoining Idaho ..... 150 *A. vallaris*
1. Herbage glaucescent; racemes 10–25-flowered, the axis 3–19 cm. long in fruit; *calyx* ± 6–7.5 mm., its teeth less than 3 mm. long; *petals* except for the white wing-tips purple, the banner 12–15 mm. long; Mohave Desert, California ..... 151. *A. cimae*

150. ASTRAGALUS VALLARIS

Low, rather coarse, with an ultimately gnarled or knotty caudex at soil-level, glabrous except for a few straight, subappressed hairs up to 0.3–0.7 mm. long on the stipules, the edges and midribs of the leaflets, and in the inflorescence, the herbage green; *stems* numerous, decumbent and radiating, 1–3 dm. long, angular-striate, com-

posed of ± 6–8 developed internodes; *stipules* 2.5–5 mm. long, membranous or membranous-margined, the lower ones ovate, obtuse, about semiamplexicaul, the upper ones narrowly ovate or lanceolate, mostly acute; *leaves* 3–7 cm. long, the uppermost ones subsessile, with 13–25 (29) oblanceolate or obovate-cuneate, retuse or mucronulate, flat or loosely folded leaflets 6–16 mm. long; *peduncles* 2–6 cm. long, much shorter than the leaf, reclinate in fruit; *racemes* shortly but loosely 5–7-flowered, the flowers widely ascending, the axis little elongating, 1.5–2 cm. long in fruit; *bracts* membranous, lanceolate, 2–4 mm. long; *pedicels* at anthesis 1.5–2 mm., in fruit thickened, 3–5 mm. long; *bracteoles* 2, affixed just below the calyx; *calyx* 9.5–11 mm. long, strigulose with black or largely black hairs, the disc ± 1.3 mm. deep, the deeply campanulate tube 5.5–6.5 mm. long, 3.6–4.5 mm. in diameter, the linear-subulate teeth 3.6–4.5 mm. long; *petals* whitish; *banner* recurved through ± 40°, 19 mm. long, the cuneate claw expanded into a rhombic-ovate blade ± 7 mm. wide; *wings* 17 mm. long, the claws ± 7 mm., the oblanceolate, obscurely erose-emarginate, nearly straight blades 11 mm. long, ± 2 mm. wide; *keel* 12–13 mm. long, the claws 7.5–8 mm., the half-obovate blades ± 6 mm. long, 3 mm. wide, incurved through 90° to the rounded apex; *anthers* 0.75–0.8 mm. long; *pod* ascending (humistrate), sometimes appearing declined in pressed specimens, stipitate, the stout, clavate stipe 5–20 mm. long, the obliquely oblong-ovoid, slightly incurved body (2) 2.5–4 cm. long, (9) 11–19 mm. in diameter, abruptly contracted at both ends, obcompressed below the short, deltoid, cuspidate beak, flattened or shallowly sulcate on the dorsal and ventral faces, rounded on the lateral angles, the sutures both elevated and cordlike, the dorsal one undulate, the thick, fleshy, green, glabrous valves becoming woody, stramineous, rugulose-reticulate, inflexed as a complete septum 3–4 mm. wide; *dehiscence* tardy, through the beak; *ovules* 26–28; *seeds* pale ocher-brown, smooth or nearly so, 3.5–3.7 mm. long.—Collections: 5 (i); representative: *Peck 26,050* (RSA, WILLU); *J. & C. Christ 17,249* (NY, RSA); *Ripley & Barneby 6570* (CAS, NY, RSA).

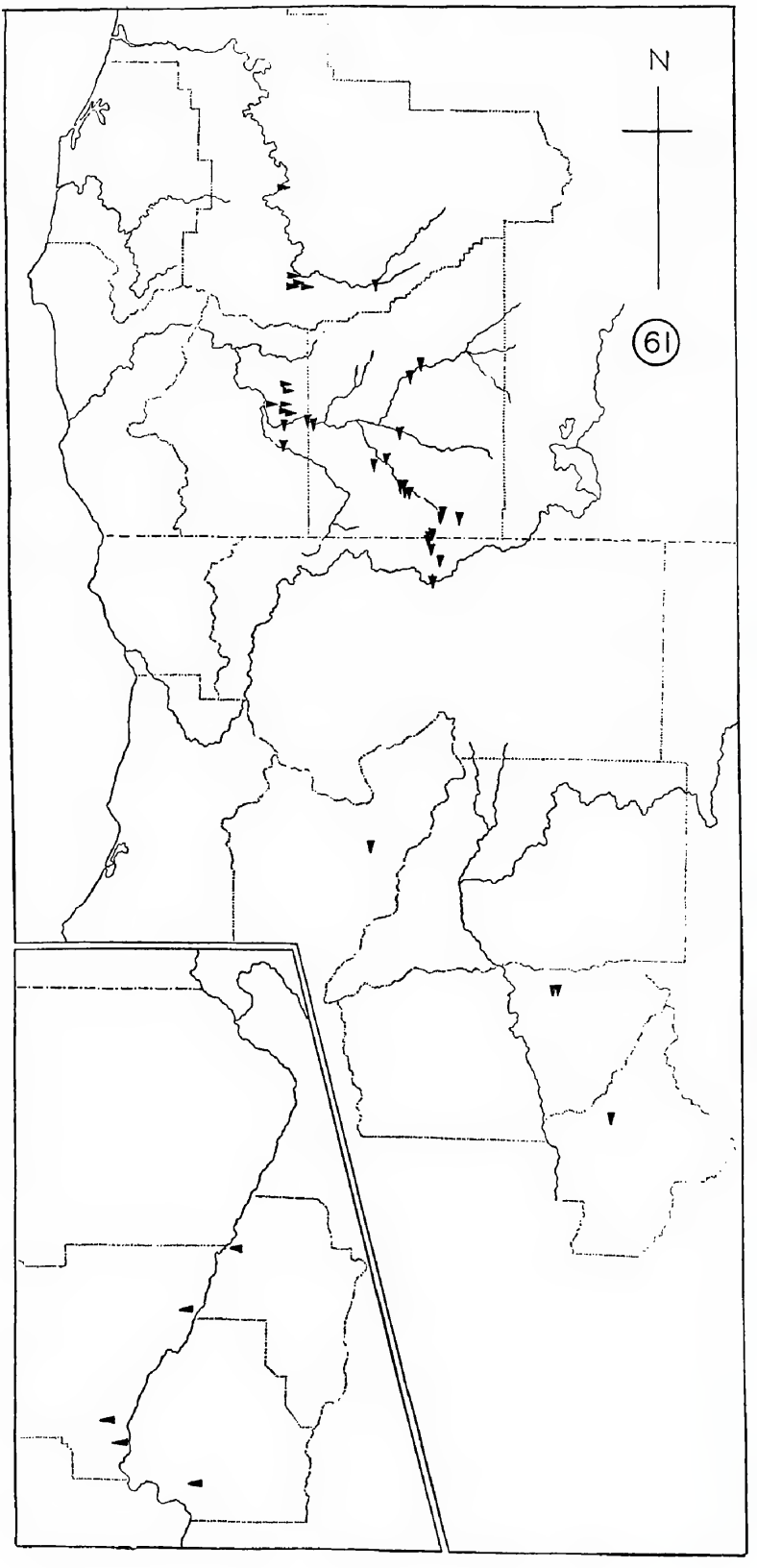
Steep brushy hillsides, often among sagebrush, about 2300–3000 feet, local, known only from the upper reaches of the Grand Canyon of the Snake River and its tributary creeks in Washington and Adams Counties, Idaho, and eastern Baker County, Oregon.—Map No. 61.—Late April to June.

ASTRAGALUS VALLARIS (of ramparts, from the boldly sculptured Snake River canyon) Jones, Contrib. West. Bot. 10: 59. 1902.—"Eastern Oregon, in Snake River Canyon, near Ballard's Landing, Cusick."—Holotypus, labeled "Ballard's Landing," POM! This specimen is apparently part of a large collection later distributed under the printed label: "Hills near Snake River, eastern Oregon, May 31, 1898, *Cusick 1910.*" Isotypi, G, GH, MO, ORE, P, UC, WS! Paratypi *(Cusick 2523),* from "Hillsides near Snake River and Pine Creek, May 25, 1901," G, K, MO, ND, NY, ORE, P, POM, US!—*Hesperonix vallaris* (Jones) Rydb. in N. Amer. Fl. 24: 439. 1929.

The Snake Canyon milk-vetch, *A. vallaris,* greatly resembles in habit of growth some prairie forms of *A. crassicarpus.* In both species the flowers develop in early spring at axils then near the summit of the stems; these continue to elongate for several weeks, and in consequence the fruits are borne near or even below the middle of the mature stem-axis. The species is easily recognized by its massive, fleshy fruits elevated on a stout, upwardly thickened stipe. The pod is like that of the next species, *A. cimae,* in outline and compression, but although usually longer and broader it encloses slightly fewer seeds. The species blooms precociously, before most botanists have taken to the field, and has been collected seldom with fresh flowers. The foregoing description of the calyx and petals, prepared from only three flowers, will no doubt need revision and extension in future.

151. ASTRAGALUS CIMAE

Low, rather coarse, with a knotty root-crown or shortly forking, superficial caudex, the stems and thick-textured, glaucescent foliage glabrous or nearly so,


N
61

the margins of the stipules sometimes beset with straight, subappressed hairs up to 0.2–0.5 mm. long, the inflorescence thinly black-strigulose; *stems* usually few, commonly 1–3 (7), decumbent with ascending tips, simple, (3.5) 6–24 cm. long, the lowest internodes short or subobsolete, the upper 2–6 developed and up to (1.5) 2.5–9 cm. long; *stipules* 5–10 mm. long, membranous, pallid, or the uppermost thinly herbaceous, all several-nerved, the lower ones broadly ovate, mostly obtuse, amplexicaul-decurrent around ± ¾ the stem's circumference, the upper ones narrower, the uppermost lance-ovate or ovate-acuminate, mostly acute; *leaves* 4.5–11 cm. long, all but the lowest subsessile, with 11–21 (23) obovate-cuneate, ovate, broadly oblong-elliptic, or suborbicular, obtuse or emarginate, flat leaflets 5–20 mm. long; *peduncles* 3–8.5 cm. long, incurved-ascending at anthesis, reclinate in fruit; *racemes* loosely 10–25-flowered, the flowers at first ascending, sometimes loosely declined in age, the axis elongating, (3) 4–12 cm. long in fruit; *bracts* membranous, pallid, broadly ovate-acuminate or lanceolate, (3) 4–6 mm. long; *pedicels* at anthesis ascending, 0.6–1 mm. long, in fruit a little thickened, arched outward, 1–2 mm. long; *bracteoles* 2, minute or up to 2 mm. long; *calyx* 5.9–7.6 mm. long, strigulose with black or mixed black and white hairs, the oblique disc 0.9–1.5 mm. deep, the membranous, purplish, deeply campanulate tube 4.5–5.6 mm. long, 2.8–3.6 mm. in diameter, the erect or spreading, subulate or triangular-subulate teeth 1.3–2.5 mm. long; *petals* reddish-purple with white or lilac wing-tips and a pale, striate lozenge in the banner, drying violet; *banner* 12–15 mm. long, the long-cuneate claw abruptly expanded into a rhombic-ovate, shallowly or deeply notched blade 6.6–8.7 mm. wide; *wings* 10.6–13 mm. long, the claws 5.1–6 mm., the narrowly oblong, obtuse or obliquely emarginate, nearly straight blades 6.1–8.4 mm. long, 2.5–3.2 mm. wide; *keel* 9.5–10.6 mm. long, the claws 4.8–5.8 mm., the broadly half-obovate blades 5.2–6 mm. long, 2.5–3.2 mm. wide, rather abruptly incurved through 80–90° to the rounded apex; *anthers* 0.55–0.75 mm. long; *pod* loosely spreading-ascending (commonly humistrate), stipitate, the stout, clavate stipe equaling or surpassing the marcescent calyx, the body oblong to broadly oblong-ovate in profile, nearly straight to greatly incurved, truncate at base, contracted distally into a deltoid or triangular-acuminate, cuspidate, laterally compressed, unilocular beak, otherwise obcompressed, openly sulcate ventrally and sometimes also dorsally, variable in size, texture, and degree of inflation, 1.5–3.7 cm. long, 8–21 mm. in diameter, the glabrous, glaucescent valves at first green suffused or dotted with red, stramineous when ripe, inflexed as a complete or nearly complete septum, but this often narrow proximally and widened upward; *dehiscence* apical, tardy, after falling; *ovules* (27) 30–36; ripe *seeds* unknown.

The Cima milk-vetch consists of two varieties, each restricted to a known range of less than ten miles diameter, and these areas of dispersal lie about one hundred and fifty miles asunder in the eastern and northern Mohave Desert. The plants of the two races are almost identical in every macroscopic detail up to the pods, but these differ greatly in size, texture, and degree of inflation. The fruit of var. *cimae* is of moderate dimensions, at first fleshy and almost solid (the small cavity filled with ovules and pulpy filaments) and becomes subligneous at maturity, when the sutures stand revealed as thickened, salient ribs. By contrast the pod of var. *sufflatus*, which is thin-walled and greatly inflated, with a large, empty cavity surrounding the ripening seeds, is a third larger or more; its ripe valves are chartaceous and its sutures remain slender and little prominent. Differences of this magnitude have traditionally sufficed, and in some cases still serve, as specific or even subgeneric criteria; some botanists may prefer to regard var. *sufflatus* as a species apart. However that may be, the two entities provide an

Map No. 61. Top, southwestern Oregon and northwestern California. Range of *A. accidens*: ◗ var. *accidens* and ◀ var. *Hendersonii*. Bottom left, northeastern Oregon and adjoining Idaho. Range of *A. vallaris*.

example of a mutation or series of mutations involving primarily and to all appearances exclusively a modification of the gynoecium's post-ovarian development. The Cima milk-vetch illustrates the fact that, in *Astragalus,* an important evolutionary step affecting the pod can occur independently of gross modifications in the plant-body, a point which has far-reaching implications for those interested in tracing natural relationships (as opposed to formalistic rearrangements) in the genus and in establishing a sound system of classification in accord with phylogenetic truth.

Key to the Varieties of A. cimae

1. Pod relatively small, the body 1.5–2.5 cm. long, 8–12 mm. in diameter, not or scarcely inflated, the valves fleshy becoming stiffly leathery or subligneous, shallowly sulcate ventrally in the lower half, the thick, prominent ventral suture there depressed and lying in an open groove, the dorsal face flattened and carinate by the salient, but more slender, undulate suture; *septum* up to 1.8 mm. wide; New York Mountains and vicinity, e. Mohave Desert ..... 151a. var. *cimae*
1. Pod larger, the body (2) 3–3.7 cm. long, 1.3–2.1 cm. in diameter, the valves thin-textured and greatly inflated, becoming papery, openly sulcate along both sutures below the beak, the sutures both slender and not or little prominent; *septum* 2–3.5 mm. wide; Inyo Mountains, n. Mohave Desert ..... 151b. var. *sufflatus*

151a. Astragalus cimae var. cimae

Pod as described in the key, its stipe 6–8 mm. long, the body usually very strongly incurved so as to bring the beak pointing in toward the raceme-axis.—Collections: 7 (ii); representative: *Ferris 7332* (DS, NY); *Munz & Everett 17,434* (NY, RSA); *Ripley & Barneby 3303, 3303a* (CAS, RSA).

Mesas and stony hillsides, in stiff, calcareous clay soils, commonly among or sheltering under sagebrush, 4700–6000 feet, very local but forming colonies, known only from the New York Mountains, the Mid Hills, and the northern end of the Providence Mountains, eastern San Bernardino County, California.—Map No. 60.—April and May.

Astragalus cimae (of Cima) Jones, Rev. Astrag. 163, Pl. 38. 1923 ("Cimae," or in indices to text and plates "cimensis," the first, associated with the description, preferable).—"Collected by Mrs. Brandgee at Cima on the edge of Nevada near the Charleston Mts. 1915."—Holotypus, dated "June, 1915" and attributed to T. S. Brandegee, POM! isotypi, UC-JEPS *(K. Brandegee),* UC *(T. S. & K. Brandegee)*! The spm. at GH, dated "May 5, 1917" and attributed to K. Brandegee is perhaps another isotypus.—*Phacomene cimae* (Jones) Rydb. in N. Amer. Fl. 24: 384. 1929.

The Cima milk-vetch is easily recognized in the eastern Mohave Desert by its diffuse, glabrous stems, thick-textured foliage of a pallid glaucescent green, bicolored flowers of moderate size, and clavately stipitate, obcompressed, bilocular pod of fleshy or at length almost woody texture. The pale lilac or white wing-tips and pallid, flabellately purple-veined lozenge on the banner form a pleasing contrast with the vinous-purple hue of the other petals, a characteristic shade which turns violet in the press. The pod's curvature is always pronounced but quite variable. It may be abruptly bent inward near the junction of body and stipe and moderately incurved thereafter; or strongly incurved throughout; or sometimes nearly straight at both ends, but abruptly and strongly hooked near the middle.

Cima, the supposed type-locality, is a railroad halt on the desert floor at the north foot of the New York Range, at an elevation of about 4250 feet. It is probable that the type-collection really came from the sagebrush plateau in the mountains several miles to the south.

151b. Astragalus cimae var. sufflatus

Identical to var. *cimae,* except for the pod, as described in the key; *stipe* 5–12 mm. long, the body varying from nearly straight to incurved through ± 90° to bring the beak erect in a plane parallel to the raceme-axis.—Collections: 3 (i); representative: *Train 701* (ARIZ, DS, OB, US); *Barneby 11,350* (CAS, GH, NY, POM, RSA, US, WS).

Calcareous clay soil, on gentle slopes and flats among sagebrush, sometimes in open piñon-forest, 5000–6000 feet, very local, known only from the east slope

of the Inyo Mountains about the south end of Saline Valley, Inyo County, California.—Map No. 60.—Late April to early June.

ASTRAGALUS CIMAE var. SUFFLATUS (blown up, of the inflated pod) Barneby in El Aliso 2: 209. 1950.—"CALIFORNIA: 15 miles north of Darwin, Inyo Co., alt. 5000 ft., 29 May 1939, *Edmund Jaeger* . . ."—Holotypus, POM! isotypi, DS, UTC!

The stipitate, inflated, fully bilocular pod of var. *sufflatus,* presumably derived from the thick-textured, solid one of var. *cimae,* is similar in outline and structure to that of *A. (Hesperonix) Bolanderi,* a species of middle elevations in the Sierra Nevada, which is distinguished by its connate stipules and many other characters. The resemblance in the fruit alone is no doubt coincidental. In the fresh state, the pod of var. *sufflatus* is glaucescent like the foliage but minutely red-dotted on a greenish ground; in ripening, it turns straw-color with reddish cheeks.

XL (iv). Subsect. MALACI

Stems loosely tufted, ascending or decumbent from a superficial or shallowly buried root-crown; *herbage* and trigonously compressed, crescentic, fully bilocular *pod* hirsute or villosulous.—Spp. 2, of the Great Basin and Snake River Plains in Nevada, extreme eastern California north of the Mohave Desert, southeastern Oregon, and southwestern Idaho.

ASTRAGALUS sect. MALACI. subsect. MALACI. *Astragalus* sect. *Malaci* Jones, Rev. Astrag. 225, sens. restr. 1923.—Sp. typica: *A. malacus* Gray.—*Hamosa* sect. *Malacae* (Jones) Rydb. in Bull. Torr. Club 54: 14, p.p. 1927.

Key to the Species of Subsect. Malaci

1. Racemes 9–25-flowered, the axis 2–10 (15) cm. long in fruit; *root-crown* superficial; *pod* hirsute with minutely bulbous-based hairs (1) 1.5–2.8 mm. long; *ovules* 16–24; w. Nevada and adjoining California to Oregon and Idaho ..... 152. *A. malacus*

1. Racemes (3) 5–10-flowered, the axis little elongating, 0.5–2 cm. long in fruit; *root-crown* shallowly buried; *pod* villosulous with filiform hairs less than 1 mm. long; *ovules* 24–30; e.-centr. Nevada ..... 153. *A. chamaemeniscus*

152. ASTRAGALUS MALACUS

Low, rather stout, with a thickened, obconical root-crown or shortly forking caudex, the stems and herbage thinly to quite densely hirsute with fine, horizontally spreading and ascending hairs up to 1.3–2.7 mm. long, green or subcanescent, the leaflets commonly bicolored, brighter green and sometimes medially glabrescent above; *stems* several, erect and incurved-ascending, 2.5–20 (25) cm. long, the lower internodes inhibited and concealed by imbricated stipules, only 1–6 distal ones developed; *stipules* 7–17 mm. long, membranous or the uppermost thinly herbaceous, several-nerved, the lowest ovate to ovate-acuminate, amplexicaul but free, the upper ones narrower, broadly lanceolate to lance-acuminate; *leaves* 4–15 cm. long, all petioled, with (7) 11–19 (21) oblong-obovate, obovate-cuneate, or elliptic, obtuse, retuse, or rarely subacute, flat or loosely folded leaflets 5–15 (20) mm. long; *peduncles* erect or incurved-ascending, sometimes reclinate in fruit, commonly stout, 4–11 cm. long; *racemes* 9–35-flowered, loose or early becoming so, the flowers at first anthesis ascending, declined in age, the fruits secund, the axis 2–10 (15) cm. long in fruit; *bracts* membranous, narrowly lance-acuminate, 4–9 mm. long; *pedicels* at anthesis 1 mm. long or less, in fruit arcuate, thickened, (0.7) 1–3 mm. long; *bracteoles* 2, often conspicuous; *calyx* 8.6–13 (14) mm. long, hirsute with black, largely black, or rarely with white or largely white hairs, the oblique disc 1–1.6 (2) mm. deep, the membranous, often purplish, cylindric tube 7–9 mm. long, 2.8–3.7 (4.5) mm. in diameter, the narrowly lanceolate teeth 1.6–4 (5) mm. long; *petals* reddish-violet with paler claws and pale, striate lozenge in the banner; *banner*

recurved through ± 45°, 15–19 (21) mm. long, the long-cuneate claw expanded into a rhombic-ovate blade 5.5–10 mm. wide; *wings* 13.8–16 (20.5) mm. long, the claws 7.6–8.7 (11) mm., the linear-oblong or -lanceolate, obtuse, nearly straight blades 7.3–9 mm. long, 2–2.7 mm. wide; *keel* 12.3–14.5 (16) mm. long, the claws 7.5–8.6 (10) mm., the obliquely half-obovate blades 5.3–6.5 mm. long, 2.4–3.6 mm. wide, gently incurved through ± 80° to the rounded apex; *anthers* 0.55–0.7 (0.75) mm. long; *pod* reflexed, stipitate, the stout stipe 1–3 mm. long (concealed by the marcescent calyx and easily overlooked), the body narrowly oblong or oblong-elliptic in profile, shallowly crescentic or evenly incurved through nearly half a circle, 1.8–3.8 cm. long, 4.5–6 mm. in diameter, cuneately contracted at base, or at both ends, but sometimes long-acuminate distally, cuspidate at apex, triquetrously compressed with acute ventral and rounded lateral angles, the shallowly grooved dorsal face narrower than the nearly flat lateral ones, the rather thin, scarcely fleshy, green but often red-mottled valves becoming stiffly papery and stramineous in age, hirsute with spreading, lustrous, straight but sometimes twisted hairs up to (1) 1.5–2.8 mm. long, inflexed as a complete septum; *dehiscence* apical and downward through the ventral suture, after falling; *seeds* brown or greenish-brown, pitted or wrinkled, 3–3.7 mm. long.—Collections: 55 (vii); representative: *Peck 25,201* (RSA); *W. H. Baker 10,131* (ID, RSA); *Maguire & Holmgren 26,257* (NY, RSA, UTC); *Ripley & Barneby 5815, 5974, 5661* (RSA); *Duran 3244* (CAS, DAV, DS, NY, OB, WIS, WS).

Dry rocky slopes, bluffs, and canyon benches, in stiff clays or light sandy soils, mostly on basaltic, perhaps rarely granitic bedrock, among sagebrush or in piñon forest, mostly 4000–7500 feet, but descending along the Snake River as low as 2600 feet, widespread and locally plentiful along the east base of the Sierra Nevada from Esmeralda County, Nevada, and Mono County, California, north through western Nevada to Lassen County, California, thence, becoming rarer, northeast into southeastern Oregon and east to the lower Snake River Plains in southwestern Idaho.—Map No. 62.—Late April to June (July).

ASTRAGALUS MALACUS (soft, of the vesture) Gray in Proc. Amer. Acad. 7: 336. 1867.—"Nevada, near Carson City, Dr. C. L. Anderson."—Lectotypus: *Anderson 26,* collected "February 23, 1864," GH! isotypus, numbered *"26"* but dated "February, 1866," US! paratypi, *Anderson 307,* GH, *in 1864,* MO, and *in 1865* NY!—*Tragacantha malaca* (Gray) O. Kze., Rev. Gen. 946. 1891. *Hamosa malaca* (Gray) Rydb., Fl. Rocky Mts. 496, 1063. 1917 *("malacra").*

Astragalus obfalcatus (inversely sickle-shaped, of the pod) A. Nels. in Bot. Gaz. 54: 411. 1912.—"Secured by MACBRIDE (No. 1023) . . . on Reynolds Creek, Owyhee County, July 3, 1911 (full fruit, flowers not seen), and by NELSON and MACBRIDE (No. 1119), at King Hill . . . July 15, 1911."—Holotypus, *Macbride 1023,* RM! paratypus *Macbride* (not *Nelson & Macbride) 1119,* RM!—*A. malacus* var. *obfalcatus* (A. Nels.) Jones, Rev. Astrag. 227, Pl. 57. 1923.

In its area of dispersal the shaggy milk-vetch, *A. malacus,* is instantly recognized by its vesture of long, straight, divaricate or widely ascending hairs (mostly over 1.5 mm. long), by the unusually long stipules and bracts of a pallidly membranous texture, and by the narrow, eventually declined and secund, reddish-violet flowers. A few sympatric *Argophylli* of similar growth-habit are pubescent with equally long, although commonly denser and often curly hairs; but in these species the raceme is fewer-flowered, and the flowers themselves remain erect as do the humistrate pods, while the latter are never bilocular or trigonously compressed. The long, lustrous hairs, which adorn the handsome, crescentic, usually red-mottled pod of *A. malacus,* are remarkable for their enlarged beadlike or bulblike bases. The pod itself, of which the beak below its terminal cusp varies from triangular to long-acuminate as viewed in profile, is in form like that of the next species, *A. chamaemeniscus;* but when fully ripe it is more strongly compressed laterally, the dorsal face being perceptibly narrower than the other two and narrowly although not deeply grooved. The populations of the shaggy milk-vetch found at low elevations along the Snake River in Idaho, one of which furnished

the typus of *A. obfalcatus,* do not differ substantially from the specific norm. The species is often grazed, but reportedly is sometimes injurious to stock (*Moore & Franklin 31,* NA).

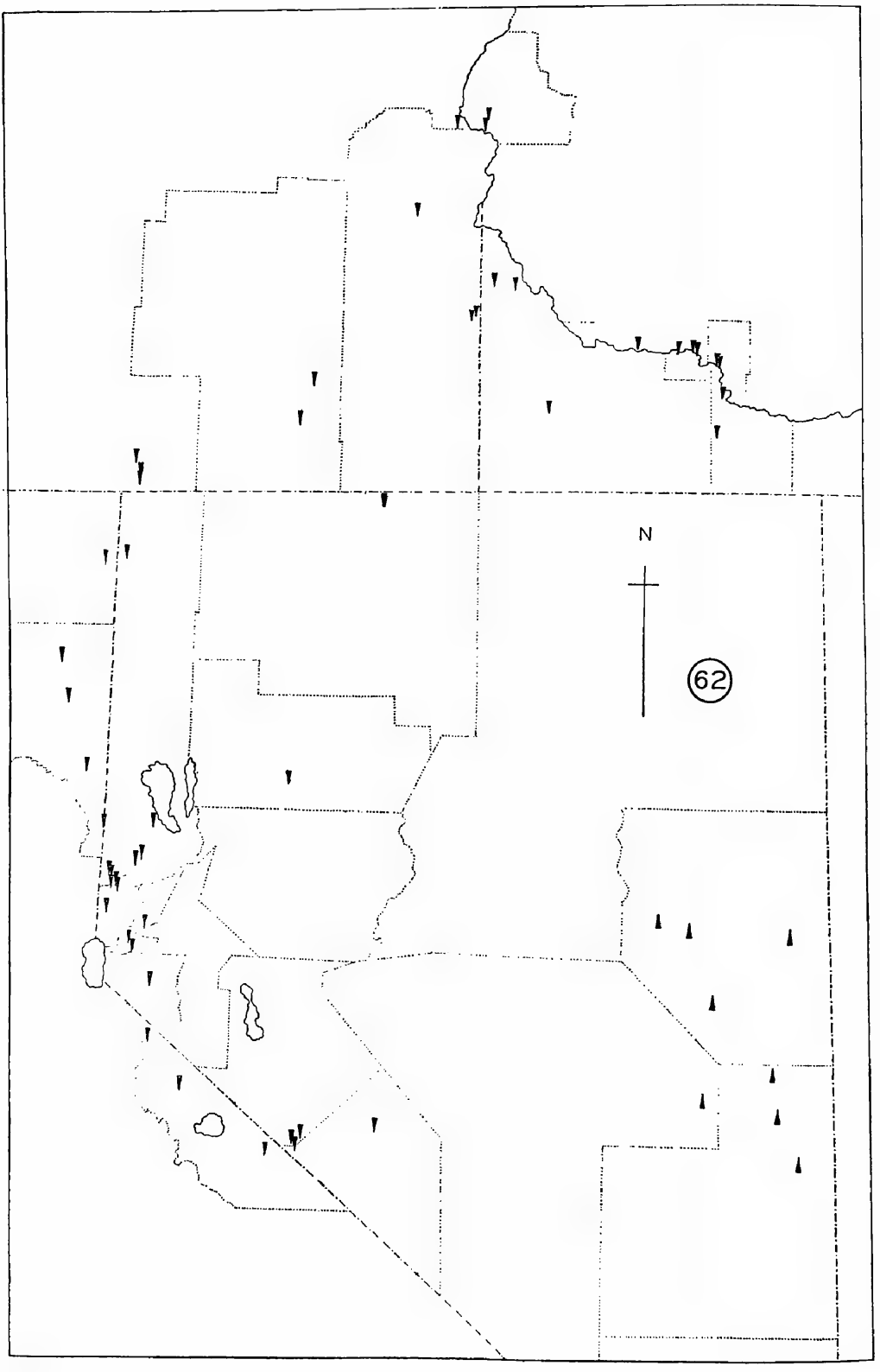
153. Astragalus chamaemeniscus

Low but relatively slender, densely or sometimes thinly villous-hirsutulous with fine, spreading and incumbent hairs up to 0.7–1.1 mm. long, the herbage canescent or greenish-cinereous, the leaflets bicolored, glabrous above; *stems* several, decumbent and radiating, 3–13 cm. long, simple or sparingly branched at base, the 2–4 lowest nodes subterranean, pallid, nearly glabrous; *stipules* membranous, 3–7 mm. long, the lower ones ovate, obtuse, semi- or almost fully amplexicaul-decurrent, the upper ones progressively narrower, the uppermost lanceolate, acute; *leaves* 2–8 cm. long, all petioled, with (9) 15–19 (21) obovate, oblong-obovate, rarely oblanceolate, obtuse or emarginate, flat or loosely folded leaflets 3–11 mm. long; *peduncles* 1.5–5 cm. long, incurved-ascending at anthesis, reclinate in fruit; *racemes* loosely but shortly (3) 5–10-flowered, the flowers ascending, the axis little elongating, 0.5–2 cm. long in fruit; *bracts* membranous, ovate- or lance-acuminate, 2.5–4.5 mm. long; *pedicels* at anthesis ± 1.5 mm. long, in fruit thickened, 1.5–3 mm. long; *bracteoles* 2, minute; *calyx* 5.8–8 (10) mm. long, the disc 0.7–1 mm. deep, the deeply campanulate or cylindric tube 4.7–7 mm. long, 2.8–3.2 (3.5) mm. in diameter, the subulate teeth 1.1–2 (3) mm. long, the ventral pair shortest and broadest; *petals* reddish-violet or clear rosy-pink, with a pale, striate lozenge in the banner, the color fugacious; *banner* recurved through ± 40°, rhombic-ovate, 13.5–16 (19) mm. long, 6.8–7.5 (9) mm. wide; *wings* 13–15 (17) mm. long, the claws ± 6 (6.5) mm., the oblanceolate, obtuse or obscurely emarginate, nearly straight blades 7.6–8.5 (9.5) mm. long, 1.9–2.2 (3) mm. wide; *keel* 10.2–11.5 (15) mm. long, the claws ± 6 mm., the half-obovate blades 5.2–5.6 (7.3) mm. long, 2.5–2.7 (3.2) mm. wide, incurved through ± 65° to the rounded apex; *anthers* 0.65–0.75 mm. long; *pod* loosely spreading, ascending, or declined (humistrate), narrowly crescentic in profile, incurved through ⅙–⅓-circle, (2) 2.5–4.5 cm. long, 5–8 mm. in diameter, cuneately contracted at base into a stout, necklike stipe 1–2.5 mm. long (this concealed by the marcescent calyx), abruptly acute or acuminate and cuspidate at apex, triquetrously compressed, with acute ventral and obtuse lateral angles, widely and openly sulcate dorsally, the green, scarcely fleshy valves becoming stramineous, leathery, prominently cross-reticulate, thinly villosulous, inflexed as a complete septum 3.5–4.2 mm. wide; *seeds* pale brown, pitted, ± 3 mm. long—Collections: 8 (v); representative: *Eastwood & Howell 9378* (CAS, NY, RSA); *McKnight & McMillan 57* (NA, NY); *Ripley & Barneby 4416* (RSA), *6270* (NY, RSA), *6332* (CAS, RSA).

Low knolls, gently sloping gullied hillsides, and valley floors, in deep, sometimes alkaline sands derived from limestone, often scattered among and taking shelter under sagebrush, 4900–6500 feet, local but forming colonies, known only from eastcentral Nevada, in northeastern Lincoln, White Pine, and adjoining Nye Counties.—Map No. 62.—Mid-April to early July.

Astragalus chamaemeniscus (ground-crescent) Barneby in Leafl. West Bot. 3: 105, Pl. opp. p. 108, fig. A. 1942.—"Nevada: . . . in the valley of the White River near Sunnyside, Nye Co., alt. 4900 ft., 25 May, 1941, fl. & fr., *Ripley & Barneby No. 3164.*"—Holotypus, CAS! isotypi, K, RSA!

The ground-crescent milk-vetch is a low and inconspicuous astragalus, but at close quarters a delightful one, with pronounced individuality. It flowers at the onset of spring weather, and the rapidly developing fruits reach their full size, although not full maturity, within a few weeks. The rather slender peduncles are quickly weighed down by the long, crescent-shaped pods which lie in a ring on the ground, often largely concealed by leaves,


N
62

and tend to fall at random angles to the raceme-axis. It is therefore difficult to say whether the fruits are by nature ascending or declined. The pod of *A. chamaemeniscus* is quite similar to that of *A. malacus* in shape and size, but it is more prominently reticulate when ripe, villosulous with much shorter hairs, and never mottled. The flowers are commonly of moderate size, the high measurements for the petals given in parentheses above being taken from a single plant which was growing with the ordinary form in western White Pine County. The petals vary from reddish-violet, the color of *A. malacus*, to a clear rosy-pink, but the pigment fades rapidly in pressed specimens.

The ground-crescent milk-vetch was collected first by Marcus Jones in the spring of 1893 in the east foothills of the Schell Creek Range near Aurum. His specimens were in flower only and were distributed (NY) as *A. cibarius*.

XLI. Sectio PRUNIFORMES

Diffuse, caulescent perennials, with taproot and superficial root-crown (sometimes buried in forest litter); *vesture* basifixed; *stipules* free; *leaves* imparipinnate with ± 19–29 thin-textured leaflets; *flowers* loosely racemose, horizontal or somewhat declined at full anthesis, of moderate size, the banner 14–19 mm. long; *calyx-tube* campanulate; *petals* whitish, regularly graduated, the banner recurved through ±45°, the keel-tip obtuse; *pod* loosely pendulous (humistrate, and often apparently ascending), stipitate, falling together with the disjointing pedicel, the plumply half-ovoid or oblong-ovoid body at first fleshy, solid, terete, becoming subligneous and a little laterally compressed, fully bilocular; *dehiscence* apparently apical, long delayed; *ovules* 11–24.—Sp. 1, xerophyte, of open woods and grasslands in cismontane southwestern Oregon and northern California.

ASTRAGALUS sect. PRUNIFORMES (Jones), stat. nov., based on *Astragalus* sect. *Reventi-Arrecti* subsect. *Pruniformes* Jones, Rev. Astrag. 159, in clave. 1923—Sp. unica: *A. accidens* Wats.

In the majority of its technical characters *A. accidens* agrees tolerably well with sect. *Malaci* subsect. *Vallares*, from which it may be distinguished by its campanulate calyx-tube and pod at once long-stipitate, fully bilocular, and at length somewhat laterally compressed and bicarinate by salient sutures. The fruit has no exact counterpart in North America, and its fancied resemblance to that of the Palestinian *A. macrocarpus* DC. brought up by Jones (1923, p. 164) is purely coincidental. In habit of growth and in ecology *A. accidens* has little in common with any *Malaci*, all of which are plants of the desert interior. It has a marked individuality because of its weakly diffuse, elongate stems and its relatively numerous submembranous leaflets. The traditional association of the species with *A. (Malaci) vallaris* possibly does express a genuine relationship, but this is certainly not an especially close one, and the manifest contemporary isolation of *A. accidens* deserves the emphasis of a monotypic section. The center of dispersal of *A. accidens* seems to lie within or at the edge of the ancient Klamath Highland, a region rich in endemic species of a relic character. It may represent an old type in its genus.

154. ASTRAGALUS ACCIDENS

Tall, diffuse, leafy perennials, with loosely forking caudex, villosulous nearly throughout with loosely ascending-incurved or somewhat curly hairs up to 0.5–0.8 (0.9) mm. long, the stems commonly stramineous and glabrescent, the herbage green or gray-green, the leaflets glabrous or thinly pubescent above; *stems* decumbent and weakly ascending, commonly numerous and radiating, 3–5.5 dm. long, leafless at base, simple or bearing spurs or branches at 1–3 nodes preceding the first peduncle, the whole composed of ± 8–12 developed internodes; *stipules* 3–6 mm. long, the lowest papery-membranous or early becoming so, ovate, decurrent around ± half the stem's circumference, the median and upper ones narrower, deltoid or triangular-acuminate, green but thin-textured, commonly reflexed, the margins ciliate and often beset with a few minute, tack-shaped processes; *leaves* widely

Map No. 62. Southwestern Idaho, northern and central Nevada, and parts of adjoining states. Range of *A. malacus*; and of *A. chamaemeniscus*.

ascending or some refracted, (3) 5–12 cm. long, the uppermost subsessile, with (15) 19–29 lance-oblong, oblong, or oblong-elliptic, nearly always emarginate or retuse, flat leaflets 6–22 mm. long; *peduncles* (4.5) 7–15 cm. long, incurved-ascending at anthesis, commonly weighed down by the heavy fruits; *racemes* 7–15-flowered, the axis a little elongating, 1.5–7.5 cm. long in fruit; *bracts* membranous, triangular-lanceolate, 1.5–3.3 mm. long; *pedicels* 1.5–3.3 mm. long, at anthesis ascending, straight or nearly so, in fruit scarcely or no longer, a little thickened, arched outward; *bracteoles* usually 2, often conspicuous, rarely 0; *calyx* 6–9.4 mm. long, villosulous with black, fuscous, or sometimes largely white hairs, the somewhat oblique disc 1.3–2 mm. deep, the tube 4.2–5.5 mm. long, 3–4.5 mm. in diameter, the broadly subulate teeth 1.7–4 mm. long, the ventral pair commonly broadest and shortest, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* whitish, drying ochroleucous or yellowish; *banner* broadly rhombic or rhombic-obovate, notched, 13.8–19.3 mm. long, 7.6–9.5 mm. wide; *wings* 12.1–15.8 mm. long, the claws 4.5–5.8 mm., the linear-oblong or oblanceolate, obtuse but erose or subemarginate, gently incurved blades 8.3–11.9 mm. long, 2.3–3.5 wide; *keel* 9.5–12.3 mm. long, the claws 4.6–5.7 mm., the lunately half-obovate or obliquely triangular blades 5.2–7.4 mm. long, 2.5–3.4 mm. wide, incurved through 85–100° to the bluntly deltoid apex; *anthers* (0.4) 0.45–0.7 mm. long; *pod* loosely pendulous (often humistrate and hence variably oriented), stipitate, the straight stipe 5–12 mm. long, the body plumply oblong-ovoid or half-ovoid, 1–2.5 cm. long, 4.5–12 mm. in diameter, abruptly contracted at both ends, beaked with a sharp, subulate, subpungent cusp, subterete and solid when first formed, becoming a little compressed laterally and bicarinate by the cordlike ventral and narrower, undulate dorsal sutures, the smooth, green, fleshy valves becoming stiffly leathery or woody, brownish-stramineous, coarsely rugulose-reticulate, inflexed as a complete septum nearly as broad as the pod's diameter; *seeds* (seldom seen) brown, sometimes purple-dotted, smooth or sparsely pitted, dull, 2.6–3.5 mm. long.

The Rogue River milk-vetch, *A. accidens,* is a coarse, weak-stemmed, sprawling and leafy astragalus, remarkable for its fleshy, stipitate pods, but it is easily identified even in the flowering stage. In its area of dispersal, where the genus is not highly developed, it could be confused only with the marginally sympatric *A. (Miselli) umbraticus;* but the latter is nearly glabrous below the black-strigulose (not villosulous) inflorescence and has decidedly smaller flowers, from which develop subsessile, incurved, compressed-triquetrous pods.

The species consists of two varieties which are essentially alike except in the size and pubescence of the pods:

Key to the Varieties of A. accidens

1. Ovary and pod pubescent; *body* of the pod 1–1.6 cm. long, (4) 4.5–7 mm. in diameter; Douglas and Josephine Counties, Oregon ..... 154b. var. *accidens*
1. Ovary and pod glabrous; *body* of the pod 1.6–2.5 cm. long, 8–12 mm. in diameter; Jackson (and immediately adjoining Douglas and Josephine) County, Oregon, s. into n. California ..... 154a. var. *Hendersoni*

154a. Astragalus accidens var. Hendersoni

Leaflets (15) 19–27, glabrous or often thinly pubescent above; *peduncles* 7–15 cm. long, mostly a little longer than the leaf; *pod* glabrous, the rather stout stipe 6–12 mm. long.—Collections: 34 (iii); representative: *Constance & Rollins 2942* (NY, ORE, WS, WTU); *Eastwood & Howell 1649, 1730* (CAS); *L. F. Henderson 5972* (CAS, ORE); *Ripley & Barneby 6700* (CAS, NY, RSA); *Barneby & Howell 11, 486* (CAS, NY, POM, RSA).

Grassy and brushy hillsides, open woods, and oak thickets, on either volcanic or granitic bedrock, 700–4000 feet, locally plentiful but somewhat scattered, common in the upper Rogue River Valley in Jackson and immediately adjoining Jo-

sephine Counties, Oregon, north just into southeastern Douglas County (Jackson Creek, upper Umpqua River), and south along the Klamath River in northcentral Siskiyou County, California, thence rarely and interruptedly southward to the upper Trinity River in Trinity County (Weaverville) and to the Cascade foothills in Tehama and Butte Counties (Paynes Creek; Butte Creek).—Map No. 61.—Late April to July.

ASTRAGALUS ACCIDENS var. HENDERSONI (Wats.) Jones, Rev. Astrag. 164, Pl. 39, 76. 1923, based on *A. Hendersoni* (Louis Forniquet Henderson, 1853–1942, sometime herbarium curator at ORE) Wats. in Proc. Amer. Acad. 22: 471. 1887 (non *A. Hendersonii* Baker, 1876). —"Open hillsides in the foothills of the Siskiyou Mountains, Josephine County, Oregon (L. F. Henderson, 1886)."—Holotypus, GH! isotypus, K!—*A. Watsoni* (Sereno Watson) Sheld. in Minn. Bot. Stud. 1: 23. 1894, a legitimate substitute. *A. pacificus* (of the Pacific) Sheld. in op. cit. 174. 1894, a superfluous substitute for the last, the supposed obstacle being *A. Watsonianus* (O. Kze.) Sheld. *A. accidens* var. *pacificus* (Sheld.) Jones, Rev. Astrag., Index. 1923, nomen. *Hesperonix Watsoni* (Sheld.) Rydb. in N. Amer. Fl. 24: 439. 1929.

Astragalus pruniformis (plum-shaped, of the pod) Jones in Proc. Calif. Acad. Sci. II, 5: 660. 1895.—"Butte County, Oregon [properly California], July, 1893, Mrs. Austin."—Holotypus, supposedly at US, not found there in 1960; isotypus (fragm.) POM!

Astragalus cymatodes (undulate, of the pod's dorsal suture) Greene, Pittonia 3: 196, 1897.—"Somewhere in the upper part of the valley of the Sacramento in California."—No collector given, but the holotypus is labeled "Butte Creek, Butte County, N. California, Mrs. R. M. Austin," ND!

The var. *Hendersoni* is by far the more widely dispersed of the two varieties of the Rogue River milk-vetch, and for numbers of populations and of individuals the more important form of the species. Its extremely broken-up distribution in California carries suggestions of age, and I suspect that the nomenclaturally typical variety is the derived mutant.

The species proposed by Jones and Greene were described in ignorance of the genuine *A. Hendersoni* and have long been recognized as synonyms. The typi of *A. pruniformis* and *A. cymatodes* are apparently parts of the same collection.

154b. ASTRAGALUS ACCIDENS var. ACCIDENS

Leaflets 23–29, glabrous above; *peduncles* mostly a little shorter than, sometimes equaling the leaf, 4.5–10.5 cm. long; *pod* loosely strigulose with incurved hairs up to 0.25–0.35 mm. long, the slender stipe 5–8 mm. long.—Collections: 14 (ii): representative: *J. W. Thompson 10,190* (CAS, NY, WTU); *T. Howell* (from Cow Creek Mts.) *in 1887* (G, ND, NY, ORE, P, WS, WTU); *Jones* (from Glendale) *in 1902* (CAS, NY, POM); *Ripley & Barneby 9536* (CAS, NY, RSA, UTC, WTU).

Dry hillsides in shade of oaks, in light gravelly soils rich in humus from decaying litter, 500–2500 feet, local but forming extensive colonies on the upper forks of the Umpqua and the middle Rogue Rivers, southern Douglas and eastern Josephine Counties, Oregon.—Map No. 61.—Late April to July, the fruits deciduous and remaining long unopened on the ground.

ASTRAGALUS ACCIDENS (falling forward, of the stems and pods) Wats. in Proc. Amer. Acad. 22: 471. 1887.—"Southern Oregon (T. J. Howell, 1881)."—Holotypus, collected April 15, 1881, US! isotypi, GH (fragm.), WS (from Roseburg)!—*Hesperonix accidens* (Wats.) Rydb. in N. Amer. Fl. 24: 438. 1929.

XLII. Sectio REVENTI-ARRECTI

Caulescent, rarely subacaulescent perennials, variable in stature, with superficial root-crown or caudex; *vesture* usually basifixed, in subsect. *Terminales* dolabriform; *stipules* free (cf. *A. obscurus*); *leaves* imparipinnate, with 11–41, rarely 7–15 leaflets; *flowers* racemose, ascending, spreading or nodding at full anthesis, variable in size, the banner 0.7–2.5 cm. long; *pedicels* thickened, persistent; *calyx-tube* deeply or shallowly campanulate, sometimes subcylindric, marcescent or circumscissile; *petals* whitish, ochroleucous, pink, or purple with pale wing-tips regularly

or irregularly graduated, the wings sometimes longest, or the keel rarely a little surpassing the wings, the banner variably recurved, the keel-tip rounded or narrowly triangular; *pod* erect or incurved-ascending to the vertical, sessile or stipitate, the body ovoid, oblong-ovoid, ellipsoid or linear-oblong, dorsiventrally or triquetrously compressed, uni- or bilocular, the valves leathery, subligneous, or papery; *dehiscence* apical, on the raceme, usually through the gaping beak and tardily downward through the ventral suture; *ovules* 14–36.—Sp. 12, xerophytes of the Great and Columbia Basins, extending east to the headwaters of the Missouri in southwestern Montana, south to southern Nevada and central Arizona; one in Baja California.

Although the prototypes of sect. *Reventi-arrecti, A. reventus* and *A. arrectus,* were discovered by two of the first naturalists to collect plants in the Columbia Basin, neither species had been described at the time of Gray's Revision (1864), and the taxonomic history goes back no further than to Jones's monograph (1923). I must mention in passing that the huge and meaningless (and moreover undescribed) sect. *Eremiticus* Sheld. might be construed, from the name-bringing species *A. eremiticus,* as a synonym but can be safely discarded as a nomen nudum. As originally delimited the *Reventi-arrecti* included, together with a core of truly interrelated species, a number of heterogeneous elements: *A. cimae* and *A. vallaris,* with decumbent stems and humistrate fruits deciduous with the disjointing pedicel; *A. accidens,* similar to the foregoing but with laterally compressed, pendulous fruits, here referred to a sect. *Pruniformes;* and *A. (Hesperonix) Bolanderi,* another monotype distinguished by connate stipules. While the section has been purged of these irrelevancies, it has been extended in these pages to embrace *A. terminalis, A. obscurus,* and *A. Orcuttianus,* mistakenly aligned by Jones in his sects. *Uliginosi, Atrati,* and *Hamosi* respectively. The present *Reventi-arrecti* correspond rather closely with *Tium* sect. *Arrecta* Rydb., although I have felt obliged to exclude *A. Michauxii* (cf. sect. *Michauxiani*) and have retrieved from an unnatural association in *Cnemidophacos* the unilocular *A. reventus* and *A. adanus.* Both Jones and Rydberg included among their *Arrecti* some taxa (in varying categories) marked off by connately sheathing stipules; these too have been removed to form a closely related but discrete group, the sect. *Conjuncti.*

Despite the narrower circumscription the section remains somewhat heterogeneous, with few characteristics common to all the species. The most important features are the free stipules and erect (cf. a minor variant of *A. eremiticus*), usually but not quite always thick-textured pod persistent on the raceme until after dehiscence through the splitting beak. The pod is otherwise variable as to compression; it may be either uni- or bilocular, and either sessile or stipitate. In the first, typical subsection the pod is sessile and unilocular except in *A. Sheldoni,* of which the semibilocular fruit either sessile or shortly stipitate provides a stage intermediate to the long-stipitate *Eremitici.* The *Arrecti* combine with the pod of either of the preceding a flower peculiarly modified by an abrupt shortening of the banner; and the monotypic *Terminales* with sessile, bilocular pod stands apart chiefly on account of the dolabriform vesture. From the small-flowered *A. remotus* of subsect. *Eremitici* the passage to the *Obscuri,* with pod again sessile and, in addition, a beaklike keel-tip and reduced number of leaflets, is not difficult; and the *Orcuttiani* might as well be included in subsect. *Arrecti,* having but few technical differentiae to back up its disparate appearance and southern desert habitat.

The *Reventi-arrecti* occupy a position morphologically central to the emmenoloboid groups with erect fruits and are probably related to the preceding section and (more or less remotely) to the next nine following. The relationships in these directions are discussed at greater length under the appropriate heading.

Key to the Subsections of Sect. Reventi-arrecti

1. Petals either regularly graduated or (rarely) subequal, but the banner never shorter than the wings (2)
   2. Pod sessile or subsessile, the stipe, if present, much shorter than the calyx-tube and not over 1.5 mm. long; Columbia and Great Basins to w. Wyoming and Montana (3)
      3. Flowers relatively large, the banner 11.5–25 mm. long, greatly surpassing the blunt keel; *leaflets* mostly over 17, less only in *Terminales* and the vesture then dolabriform; *pod* ovoid to oblong-ellipsoid, over 3.3 mm. in diameter, the fleshy valves becoming leathery or woody; s. Idaho n.-ward (4)
         4. Vesture basifixed, the herbage green or rarely subcinereous, the 17–41 leaflets glabrous or nearly so above ..... XLII (i). Subsect. *Reventi-arrecti*

4. Vesture dolabriform, the herbage silvery-canescent throughout, the leaflets 13–21 ..... XLII (ii). Subsect. *Terminales*
3. Flowers small, the banner 7–10.5 mm. long, about equaling the wings and keel, the keel-tip narrowly triangular and beaklike; *leaflets* 7–13 (15); s.-centr. Idaho s. through the Great Basin to Nevada and n.-e. California ..... XLII (vi). Subsect. *Obscuri*
2. Pod stipitate, the stipe mostly 2.5–18 mm., in *Orcuttiani* of Baja California only 1.5–3 mm. long (5)
5. Pod straight or nearly so; *flowers* commonly ochroleucous, purple with pale wing-tips only in some forms of *A. eremiticus,* but the banner then well over 12 mm. long; centr. Arizona and s. Nevada n.-ward ..... XLII (iv). Subsect. *Eremitici*
5. Pod gently and evenly incurved to the vertical; *flowers* pink, small, the banner about 10.5–12 mm. long; Baja California ..... XLII (v). Subsect *Orcuttiani*
1. Petals irregularly graduated, the banner (1) 1.5–4 mm. shorter than the wings; e. Washington and w.-centr. Idaho ..... XLII (iii). Subsect. *Arrecti*

XLII (i). Subsectio Reventi-arrecti

Vesture basifixed, usually scanty; *leaflets* 17–41; *flowers* large, whitish or ochroleucous, the banner about 1.5–2.5 cm. long; *pod* erect, sessile or obscurely stipitate, the stipe not over 1.5 mm. long, the body broadly ovoid to narrowly oblong-ellipsoid, uni- or semibilocular, the fleshy valves becoming leathery or subligneous.—Spp. 3, of southeastern Washington and northeastern Oregon to southern Idaho.

Astragalus sect. Reventi-arrecti Jones, Rev. Astrag. 158. 1923, sens. restrict.—Sp. lectotypica: As *reventus* Gray.

Astragalus sect. *Reventi-arrecti* subsect. *Reventi* Jones, Rev. Astrag. 159, in clave. 1923.

Key to the Species of Subsect. Reventi-arrecti

1. Stems (2) 2.5–4.5 dm. long, composed of 5–10 developed internodes, the main axis evidently longer than the peduncles and racemes together; *ovary* and unilocular pod glabrous; *ovules* 14–18; s. Idaho, s.-ward from Boise and Custer Counties, to Utah ..... 157. *A. adanus*
1. Stems commonly less than 2 dm. long, composed of 2–5 (7) developed internodes and the main axis nearly always shorter than the inflorescences or, if sometimes taller (as in *A. Sheldoni*) then the *ovary* and semibilocular pod pubescent; *ovules* 20–36; Idaho County, Idaho, to n.-e. Oregon and adjoining Washington (2)
2. Ovary and pod glabrous, the pod ovoid-oblong or broadly oblong-ellipsoid, 7–10 mm. in diameter, very shallowly if at all sulcate dorsally, the valves usually not inflexed, the septum, if any, less than 1 mm. wide; Blue Mountains, n.-e. Oregon and immediately adjoining Washington ..... 155. *A. reventus*
2. Ovary and pod commonly pubescent, rarely glabrous, the pod narrowly oblong-ellipsoid, (4) 4.5–6.3 mm. in diameter, openly sulcate dorsally, semibilocular, the septum 1–1.6 mm. wide; about the lower Salmon and adjoining Snake Rivers, n.-e. slope of the Wallowa Mountains, Oregon, and adjoining Idaho ..... 156. *A. Sheldoni*

155. Astragalus reventus

Rather coarse, densely or loosely tufted, shortly but definitely caulescent, with a woody taproot and knotty, shortly forking caudex, strigulose or villosulous with all appressed or subappressed and straight, or all spreading and incumbent, fine, filiform or slightly flattened hairs up to 0.5–0.85 (1.2) mm. long, the herbage green or rarely grayish-silky, the leaflets glabrous or nearly so above; *stems* several or numerous, commonly stout and striate, erect or decumbent at base and thence ascending, (2.5) 8–18 cm. long, the main axis less than half the height of the fully grown plant, composed of 2–5 (6) developed internodes, the longest of them (usually that preceding the first peduncle) up to 1.5–10 cm. long; *stipules* membranous, early becoming papery, pallid or brownish, 3.5–9 mm. long, the lowest ovate or lance-oblong, the upper triangular or lance-acuminate, all conspicuously adnate to the petiole-base, decurrent around about half the stem's

circumference, or the lowest fully amplexicaul but not connate, the margins commonly beset with a few processes; *leaves* (6) 8–18 (21) cm. long, with rather stiff (the upper short) petioles and (17) 23–41 rather scattered, lance-oblong or -ovate, oblanceolate, or narrowly elliptic, or (in some upper leaves) linear, obtuse, retuse, or acute, flat or folded leaflets 5–21 mm. long; *peduncles* stout, erect, 1–2 dm. long, surpassing the leaves; *racemes* 8–21-flowered, at first rather dense, early elongating and looser, the flowers loosely spreading or nodding, the axis (2.5) 4–10 cm. long in fruit; *bracts* membranous, lanceolate, 2.7–5.5 mm. long; *pedicels* at anthesis a little arched outward or recurved, 1.4–2 mm. long, in fruit erect or narrowly ascending, clavately thickened, 3–5.4 mm. long; *bracteoles* commonly 2, sometimes vestigial or 0; *calyx* (8.9) 10.7–14.8 mm. long, loosely strigulose or villosulous with black or mixed black and white or fuscous hairs, the oblique disc 0.9–1.4 mm. deep, the membranous, pallid, deeply campanulate, dorsally convex tube (6.2) 6.8–9.8 mm. long, (3.8) 4–5.4 mm. in diameter, the lance-subulate teeth (2.2) 3–5.2 mm. long, the ventral pair commonly broader but either longer or shorter than the rest, the whole becoming papery, irregularly circumscissile; *petals* white or creamy-white, immaculate; *banner* recurved in a gradual arc through nearly 90°, oblanceolate or rhombic-oblanceolate, shallowly notched, (15.2) 16.2–24 (25.3) mm. long, 6–10 mm. wide; *wings* (14.6) 16.2–21.3 mm. long, the claws (6.2) 7.6–10.1 mm., the elliptic-oblanceolate, obtuse or obliquely subemarginate, slightly incurved blades 9.7–13 mm. long, 2.2–3.7 (4.4) mm. wide; *keel* (12.1) 13–16.3 mm. long, the claws (6.2) 6.8–9.5 mm., the obliquely triangular or rarely obliquely elliptic blades abruptly incurved through 90° (rarely gently so through only 65°) to the rather sharply deltoid, sometimes minutely porrect apex; *anthers* 0.7–1 mm. long; *pod* erect, sessile, obliquely ovoid-acuminate to broadly lance- or oblong-ellipsoid, (1.5) 1.7–3 cm. long, 7-10 mm. in diameter, straight or a trifle incurved, rounded, broadly cuneate, or truncate at base, contracted distally into a triangular-acuminate, slightly compressed, rigidly cuspidate beak, otherwise a little obcompressed, carinate ventrally by the thick, blunt, cord-like suture, flattened or very widely and shallowly sulcate dorsally, the dorsal suture commonly prominent but thinner than the ventral one and often undulate, the green, fleshy, glabrous valves becoming stiffly leathery or woody, stramineous or brownish, transversely rugulose-reticulate and often also wrinkled lengthwise, either not inflexed or inflexed as an obscure partial septum up to 0.9 mm. wide; *ovules* 25–36; *seeds* olivaceous or deep mahogany-brown, smooth but dull, 2.7–3.4 mm. long.—Collections: 20 (o); representative: *Hitchcock & Muhlick 8317* (CAS, NY, WS, WTU); *Pierce & Dillon 802* (CAS, WS, WTU); *Cusick 3458* (WS); *Cronquist 6572* (CAS, ID, NY, SMU, TEX, WS); *Peck 26,351* (RSA, WILLU).

Dry, rocky slopes, knolls, and hilltops, in open yellow pine forest, 3000–5000 feet, occasionally a little lower, locally common in the Blue Mountains of northeastern Oregon, particularly on the upper forks of the Umatilla and Grande Ronde Rivers, extending northeast into extreme southeastern Washington.—Map No. 63.—April to July, the fruit persisting into fall.

ASTRAGALUS REVENTUS (returned, in allusion to the lapse of 48 years between the original and second discoveries) Gray in Proc. Amer. Acad. **51**: 46. 1879.—"Interior of Oregon, Douglas, in fruit.... now collected in Grand Round Valley and Blue Mountains in the eastern part of Oregon, in April, 1878,... by William C. Cusick; and... in Klickitat Valley, Washington Territory, by Joseph Howell."—Cotypi, *Douglas* (fr.) and *Cusick 593* (fl.), both GH! isotypi (*Douglas*, variously labeled), BM, G, K, P! the Howell collection is *A. reventiformis*.—*Phaca reventa* (Gray) Piper in Contrib. U. S. Nat. Herb. **11** (Fl. Wash.): 372. 1906. *Cnemidophacos reventus* (Gray) Rydb. in Bull. Torr. Club **40**: 52. 1913.

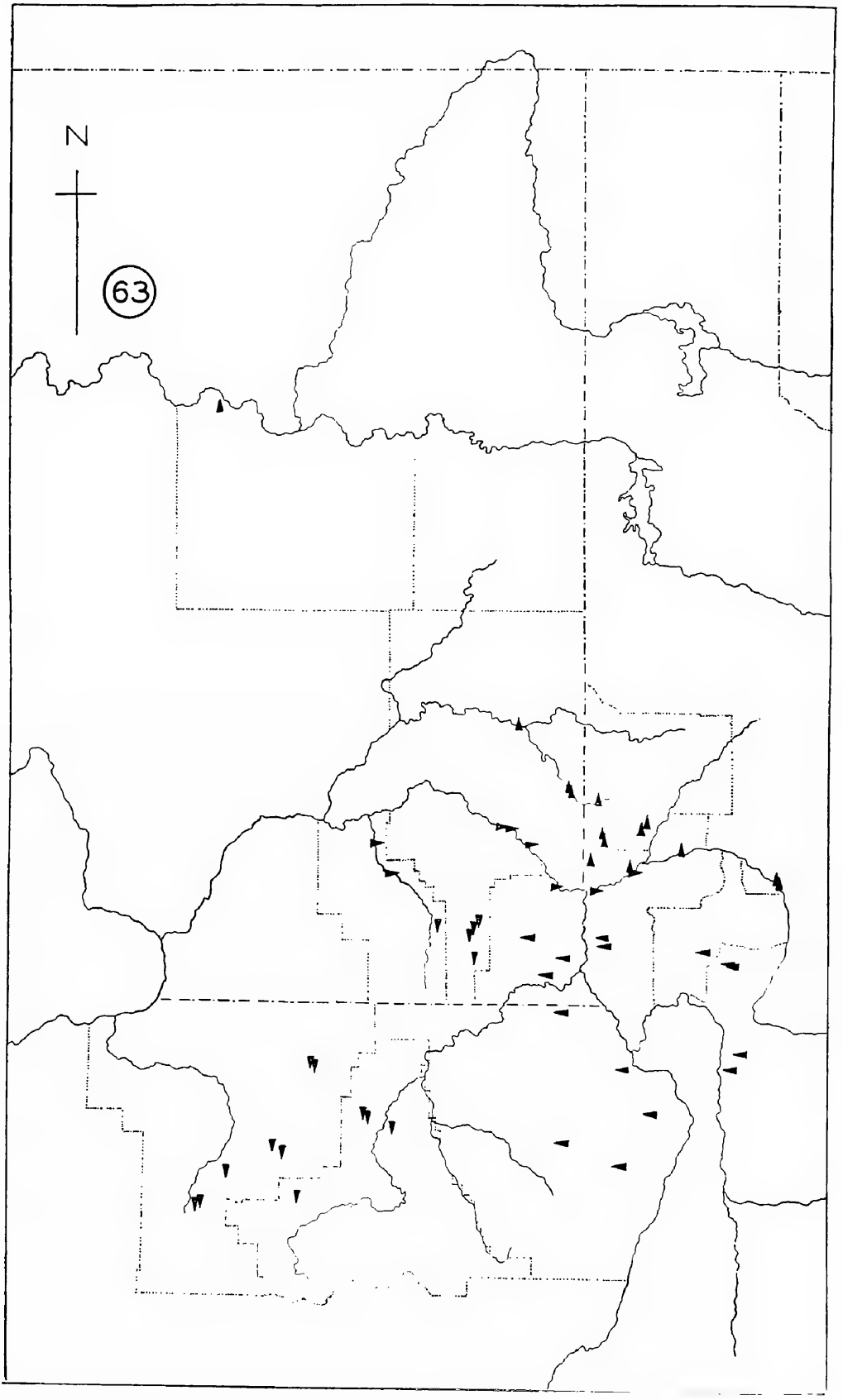
The Blue Mountains milk-vetch is a rather handsome, coarse species, remarkable for the

numerous, scattered, early deciduous leaflets, stout peduncles proportionately very long for the total height of the plant, and large, fleshy, persistent pods of rigidly leathery or woody texture when ripe, unilocular or nearly so. The populations vary considerably in flower-size and in orientation of the hairs on the leaves, which may be truly appressed or incumbent and villosulous. The largest flowers seem to occur toward the southwest limit of the species on the divide between the Umatilla and the Grande Ronde, and are commonly associated with a loose type of vesture. The plants flower very early in the season, and consequently there is too little material at this stage of development to draw conclusions as to the racial situation in the species.

In growth-habit and form of the pod *A. reventus* rather closely resembles *A. reventiformis* and *A. conjunctus,* species of sect. *Conjuncti* distinguished by their scarious, connate lower stipules. The first is found far to the west in the foothills of the Cascade Range, but *A. conjunctus* is widely dispersed in the mountains of eastern Oregon and is known to occur within a mile or two of *A. reventus* in southern Umatilla County. It is especially easy to distinguish when in flower, as the calyx-tube (only 2.5–4 mm. in diameter) is narrower relative to its length and thus cylindric or nearly so, and all the petals, or at least the keel-tip, are suffused with pinkish- or bluish-purple. The relationship of *A. reventus* to *A. Sheldoni* is considered below.

156. Astragalus Sheldoni

Usually stout and rather coarse, with a thick, woody taproot and shortly forking suffruticulose caudex, strigose-pilosulous with fine, ascending and incumbent hairs up to 0.5–0.9 mm. long, the pale green or stramineous, striate stems thinly so, the herbage greenish or cinereous on the lower surface, the leaflets glabrous above; *stems* several, erect and ascending in clumps, simple above the immediate base, (3) 5–38 cm. long, composed of 3–7 developed internodes up to 2.5–12 cm. long, the whole commonly shorter, sometimes a little longer than the longest inflorescence; *stipules* 3–10 mm. long, the lowest adnate (sometimes through 4 mm.) to the petiole-base, papery-scarious or early becoming so, ovate or ovate-acuminate, amplexicaul-decurrent around half or a little more of the stem's circumference, the upper ones narrower, more shortly adnate, with lance-acuminate, mostly erect, subherbaceous blades, their margins commonly beset with a few minute processes; *leaves* 7–19 cm. long, the lowest long-petioled, the upper more shortly so, with (17) 23–35 (39) oblong-obovate, elliptic, or narrowly oblanceolate, retuse, obtuse, or sometimes subacute, flat leaflets 5–22 mm. long; *peduncles* stout, stiffly erect, (11) 16–30 cm. long; *racemes* loosely 10–30 (35)-flowered, the flowers nodding and at early anthesis retrorsely imbricated, the axis early elongating, (3) 6–16 cm. long in fruit; *bracts* submembranous, linear- or lance-acuminate, 2.5–9 mm. long; *pedicels* at anthesis arched outward, 1.3–2 mm. long, in fruit clavately thickened, erect, 2.5–6 mm. long; *bracteoles* 0–2; *calyx* 8.5–12.6 mm. long, thinly strigulose-pilosulous with black or mixed black and white hairs, the oblique disc 0.9–1.4 mm. deep, the membranous, pallid, deeply campanulate tube 5.6–7.5 mm. long, 3.5–4.8 mm. in diameter, the subulate or linear-subulate teeth 2–5.2 (6) mm. long, either erect or arcuately spreading or recurved, the whole becoming papery-scarious, ruptured but marcescent; *petals* white or creamy-white, immaculate; *banner* gently recurved through about 45°, rhombic-oblanceolate or -obovate, shallowly notched, 15.5–21.5 mm. long, 7–11 mm. wide; *wings* 13.4–19 mm. long, the claws 6.2–9 mm., the nearly straight, obliquely oblong-oblanceolate, obtuse or emarginate blades 8–11.8 mm. long, 2.5–4.2 mm. wide; *keel* 11.5–14.4 mm. long, the claws 5.9–8.4 mm., the lunately half-elliptic blades 5.6–7.6 mm. long, (3.2) 3.7–4 mm. wide, gently or rather abruptly incurved through 75–85 (90°) to the sharply deltoid apex; *anthers* 0.7–0.9 mm. long; *pod* erect, sessile or elevated on an obscure, stout stipe up to 1.5 mm. long, the body narrowly oblong-ellipsoid, (1.5) 1.7–2.3 cm. long, (4) 4.5–6.3 mm. in diameter, straight or a trifle incurved, abruptly obtuse or truncate at base, contracted distally into a triangular-acuminate, sharply cuspidate, laterally compressed


N
63

beak, otherwise obcompressed, keeled ventrally by the prominent, thick ventral suture, openly grooved dorsally, the green, fleshy, at length leathery and stramineous, transversely rugulose-reticulate valves either minutely strigulose with black or white, incumbent hairs or exceptionally glabrous, inflexed as a partial or nearly complete septum 1–1.6 mm. wide; *ovules* (20) 24–31; *seeds* brown, smooth but dull, 2.3–2.6 mm. long.—Collections: 22 (i); representative: *Maguire & Holmgren 26,711* (CAS, WS); *J. R. Murphy 73* (NY, SMU, WS); *J. & C. Christ 16,553, 16,576* (NY, RSA); *Ripley & Barneby 10,744* (CAS, RSA); *W. H. Baker 6720* (ID, RSA).

Stony meadows, bunchgrass prairies, or rocky hillsides among low sagebrush, in deep, dry soils derived from basalt, 1750–3500 (4200) feet, locally plentiful in the hill country about the lower Salmon and adjoining Snake Rivers in Idaho, Lewis, and Nez Perce Counties, Idaho, Asotin County, Washington, and along creeks running to the Snake on the northeastern slope of the Wallowa Mountains, Wallowa County, Oregon.—Map. No. 63.—May to July, the fruit long persisting.

ASTRAGALUS SHELDONI (Rydb.) Barneby in Amer. Midl. Nat. 55: 489. 1955, based on *Tium Sheldoni* (Edmund Perry Sheldon, 1869– , author of a systematic list of North American *Astragali* in 1894) Rydb. in N. Amer. Fl. 24: 393. 1929.—"Type collected in Horse Creek Canyon, Wallowa County, Oregon, May 14, 1897, *Sheldon 8032* . . ."—Holotypus, NY! isotypi, MO, US! *A. conjunctus* var. *Sheldoni* (Rydb.) Peck, Man. Pl. Ore. 448. 1940 & in Madroño 6: 135. 1941. *A. reventus* var. *Sheldoni* (Rydb.) C. L. Hitchc. in Univ. Wash. Pub. Biol. 17: 257. 1961.

The Sheldon milk-vetch is closely related to *A. reventus*, differing consistently only in its narrower, more nearly bilocular pod; but its specific status is reinforced by different modes of variation in many organs (especially the common presence of a short stipe and shorter calyx-tube) and by its vicariant range of dispersal. Whereas *A. conjunctus* is confined to the granitic formations of the Blue Mountains, the present species is as rigidly restricted to basalt soils. The majority of the populations of *A. Sheldoni* are distinguished further by their pubescent ovary and pod strigulose with either white or black hairs, but a glabrous-fruiting form is known from a small area near the mouth of the Grande Ronde in Asotin County, Washington (cf. *Sheldon 8236*, NY, UC; *Head 671, 681*, RSA), while both phases occur close together on the opposite side of the Snake River in Nez Perce County, Idaho (cf. *Christ 14,204, NY; W. H. Baker 8921*, ID, RSA). In the valley of the Clearwater *A. Sheldoni* is sometimes associated with *A. collinus*, and the two species, alike in their dense racemes of nodding, retrorsely imbricated flowers, have now and then been needlessly confused. The basally pouched calyx and shortened, sigmoidally arched banner of *A. collinus* are amply distinctive even without the beginnings of the pendulous, long-stipitate, unilocular fruit. The Sheldon milk-vetch was first collected in 1884, in Nez Perce County, Idaho, by J. B. Leiberg (ORE).

157. ASTRAGALUS ADANUS

Robust and leafy, with a woody taproot and shortly forking, sometimes knotty caudex, thinly pilosulous or loosely strigulose with fine, loosely ascending, incurved, or subappressed hairs up to 0.5–0.7 mm. long, the stems commonly subglabrous, the herbage green or exceptionally gray-silky when young, the leaflets glabrous above, the inflorescence usually fuscous- or black-pubescent; *stems* several or numerous, erect and ascending in clumps, (2) 2.5–4.5 dm. long, striate, pale green or stramineous in age, composed of 5–10 developed internodes, the whole evidently longer than the inflorescences; *stipules* membranous, 4–9 mm. long, shortly adnate to the petiole-base, the lowest early becoming papery, decurrent around half to nearly the whole stem's circumference, the median and upper ones narrower, with triangular or lance-acuminate, erect or deflexed blades, their margins commonly beset with a few minute processes; *leaves* 7–13 (16) cm. long,

Map No. 63. Southeastern Washington and adjacent parts of Oregon and Idaho. Range of *A. reventus*; of *A. Sheldoni*; of *A. arrectus*; and of *A. riparius*.

the lower ones slender-petioled, the upper subsessile, with (13) 17–27 ovate, oblong, lance-oblong, or broadly elliptic, retuse or obtuse, flat, thin-textured leaflets 6–26 mm. long; *peduncles* erect, (4) 10–18 cm. long, equaling or commonly surpassing the leaf; *racemes* (4) 7–22-flowered, the flowers subcontiguous, ascending or subhorizontal at anthesis, the axis early elongating, (2) 3–8 cm. in fruit; *bracts* membranous, lanceolate or ovate-acuminate, 1.5–3.5 mm. long; *pedicels* at anthesis slender, 1–1.5 mm. long, in fruit ascending, clavately thickened, 2.5–5 mm. long; *bracteoles* nearly always 2; *calyx* 6.9–10.3 mm. long, finely pilosulous with black, fuscous, or partly white hairs, the oblique disc (0.8) 1–1.5 mm. deep, the membranous, subtumid, deeply campanulate to subcylindric tube 5.2–8 mm. long, 3.5–4.4 mm. in diameter, strongly convex dorsally but not gibbous basally, the broadly triangular-subulate to lanceolate teeth 1.6–2.8 mm. long, the ventral pair commonly broadest, the whole becoming papery, fragile, irregularly circumscissile; *petals* ochroleucous, immaculate; *banner* recurved through ± 45°, broadly rhombic-elliptic or -oblanceolate, 15.5–22 mm. long, 6.2–10.6 mm. wide; *wings* 13.5–20.2 mm. long, the claws (5.6) 6.5–8.6 mm., the oblong-oblanceolate, obtuse or obliquely emarginate, nearly straight blades 9–13.2 mm. long, 2.7–3.5 mm. wide; *keel* 11–13.1 mm. long, the claws 5.5–8 mm., the half-obovate blades 5.3–7.7 mm. long, 2.8–3.5 mm. wide, abruptly incurved through 90° to the bluntly deltoid apex; *anthers* 0.55–0.75 mm. long; *pod* erect, sessile, obliquely ovoid or oblong-ovoid, 1.3–1.8 cm. long, 5–6 mm. in diameter, obtuse at base, abruptly contracted distally into a short, pungently cuspidate beak, straight or a trifle incurved, a little dorsiventrally (in some dried specimens apparently laterally) compressed, bicarinate by the thick, prominent sutures, esulcate, the green, fleshy, glabrous valves becoming brownish-stramineous, stiffly leathery or subligneous, transversely rugulose-reticulate and often wrinkled lengthwise, not inflexed; *ovules* 14–18; *seeds* brown, smooth but punctate, 2.5–3.5 mm. long.—Collections: 25 (ii); representative: *M. & G. Ownbey 3060* (CAS, NY, RSA, SMU, WS); *Hitchcock & Muhlick 8561* (CAS, NY, RSA, WS); *C. L. Hitchcock 15,549* (NY, RSA, WS); *Ripley & Barneby 10,675* (CAS, NY, RSA); *Christ & Ward 7001* (ID, NY).

Brushy slopes, terraces and benches along canyons, or on dry flats and gently rolling hill country among sagebrush, in alluvial clays and gravels of both granitic and basaltic origin, 2700–6000 feet, not rare in southwestern Idaho in the valleys of the Weiser, Payette, and Boise Rivers, east to the head of Camas Creek in Camas County, north just across the crest of the Sawtooth Range in Custer County, and apparently isolated to the south of the Snake River in the Goose Creek Mountains, Cassia County, and at the west base of Mt. Nebo in eastern Juab County, Utah.—Map No. 64.—May to July.

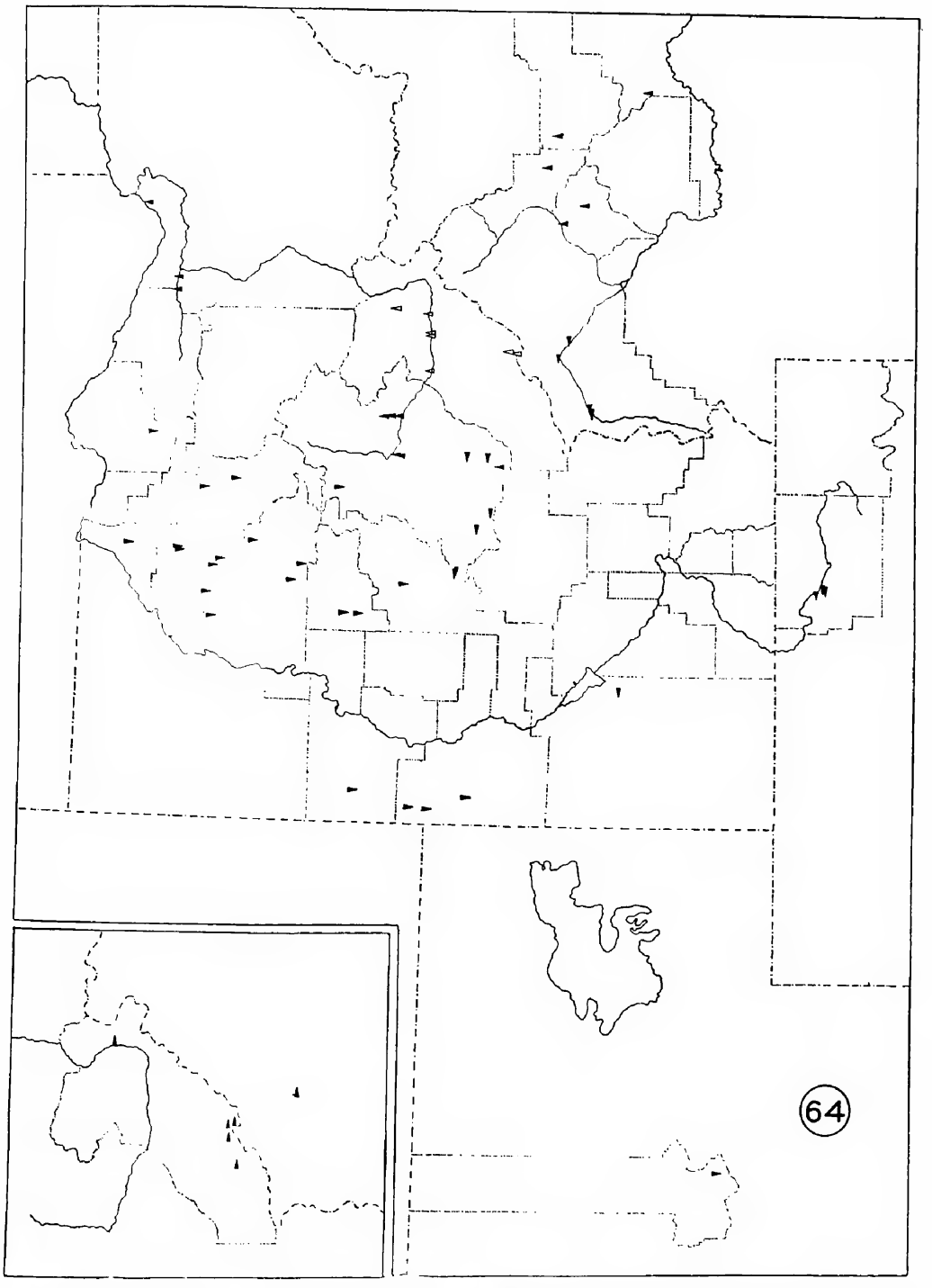
ASTRAGALUS ADANUS (of Ada County) A. Nels. in Bot. Gaz. 53: 222. 1912.—"...in the Boise Hills, No. 260 by MACBRIDE, June 18, 1910."—Holotypus, RM! isotypi, G, GH, MO!—*Ctenophyllum adanum* (A. Nels.) Rydb., Fl. Rocky Mts. 1063. 1917. *Cnemidophacos adanus* (A. Nels.) Rydb. in N. Amer. Fl. 24: 285. 1929.

The Boise milk-vetch, *A. adanus,* is one of several moderately tall, leafy, white-flowered astragali of the intermountain region; lacking any immediately striking feature at anthesis, it is not easily identified without the fruit. The pod is similar in form and in its fleshy, at length subligneous texture to that of *A. reventus,* but it is shorter and of a more plumply ovate outline. The species varies little, and the populations isolated to the south of the Snake River do not differ perceptibly from those in the main range. The Boise milk-vetch was probably first collected in 1881, in Ada County, by E. V. Wilcox (NY).

XLII (ii). Subsectio TERMINALES

Vesture dolabriform, silvery; *leaflets* mostly 13–21; *flowers* of moderate size, white faintly lilac-tinged, the banner ± 12–16.5 mm. long; *pod* erect, sessile,

oblong or oblong-ovate in profile, obcompressed below the beak, flattened or openly grooved dorsally, semi- or fully bilocular, the fleshy valves becoming



Map No. 64. Right, southern Idaho and parts of adjoining states. Range of ◗ *A. adanus*; of ◆ *A. terminalis*; and of *A. atropubescens*: ◖ pod glabrous; ◊ pod pubescent. Lower left, Lemhi County, Idaho, and Beaverhead County, Montana. Range of *A. scaphoides*.

stiffly leathery.—Sp. 1, of southcentral Idaho to southwestern Montana and northwestern Wyoming.

ASTRAGALUS sect. REVENTI-ARRECTI subsect. TERMINALES, subsect. nov., pube densa nitida dolabriformi inter *Reventos-arrectos* insignes, caeterius omnino cum subsectioni typica congruentes.—Sp. unica: *A. terminalis* Wats.

158. ASTRAGALUS TERMINALIS

Of low or moderate stature, with a thick, woody taproot and knotty, shortly forking caudex, densely strigulose (except the glabrous pod) with a coat of straight, appressed, subcontiguous hairs, the herbage silky-canescent, the leaflets sometimes a little more thinly pubescent above than beneath and greenish, the inflorescence commonly nigrescent; *stems* usually few, decumbent and incurved-ascending, (2.5) 5–15 (20) cm. long, composed of 2–6 flexuous or zigzag internodes up to 2–7 cm. long, the whole commonly shorter than the longest peduncle and raceme together; *stipules* submembranous, all shortly adnate to the petiole-base, the lowest ovate, early becoming papery-scarious, amplexicaul-decurrent around ¾ to the whole stem's circumference but not connate, the median and upper ones narrower, with triangular or lanceolate, erect or deflexed blades; *leaves* (3) 5–17 cm. long, all petioled, with (11) 13–21 oblong-obovate or ovate and truncate to deeply retuse, or linear-oblong or -elliptic and obtuse or subacute, flat or folded leaflets 3–17 mm. long; *peduncles* mostly incurved-ascending, 6–20 (24) cm. long, surpassing the leaf; *racemes* loosely (in early anthesis sometimes compactly) 7–25 (30)-flowered, the flowers nodding, the axis elongating and (1.5) 3–12 (16) cm. long in fruit; *bracts* membranous, ovate or lanceolate, 1–2.5 mm. long; *pedicels* at anthesis slender, arched outward, 0.7–1.5 mm. long, in fruit ascending, straight, thickened, 2–5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 4.5–7 mm. long, densely strigulose with black or mixed black and white hairs, the subsymmetric disc 0.7–1.2 (1.4) mm. deep, the campanulate tube 3.8–5.5 mm. long, (2.4) 2.7–3.5 mm. in diameter, the triangular-subulate, obtuse teeth 0.7–1.2 (1.5) mm. long, the ventral pair commonly directed away from the broad, deeply cut ventral sinus, the whole becoming papery-scarious, fragile, ruptured but marcescent; *petals* white or milky-white, sometimes faintly suffused with bluish-lilac, the keel-tip always prominently maculate; *banner* abruptly recurved through ± 90°, ovate-cuneate, (11.2) 12.5–16.6 mm. long, 6.6–9 (11) mm. wide; *wings* (10.7) 12.5–15.6 mm. long, the claws (4.2) 4.5–5.4 mm., the lunately oblanceolate, obtuse or rarely obliquely emarginate blades (7.1) 8.7–11 mm. long, 2.6–4.2 mm. wide; *keel* 8.8–10.7 mm. long, the claws 4.3–5.3 mm., the half-obovate blades 4.5–5.7 mm. long, 2.7–3.2 mm. wide, abruptly incurved through 95–105° to the bluntly deltoid apex; *anthers* 0.55–0.75 mm. long; *pod* erect, sessile, narrowly oblong or ovate-oblong in outline, 12–17 mm. long, 3.3–6.3 mm. in diameter, nearly straight or slightly incurved, obtuse at base, contracted distally into a short, triangular, laterally compressed, cuspidate beak, otherwise obcompressed, keeled ventrally by the prominent, thick, cordlike suture, flattened or commonly openly grooved dorsally, the lateral angles plumply rounded, the green, fleshy, glabrous valves becoming stramineous, leathery, transversely rugulose-reticulate and (parallel and close to the ventral suture) wrinkled lengthwise, inflexed as a partial or nearly complete septum 0.7–1.1 mm. wide; *ovules* 24–36; *seeds* dark green suffused or thickly speckled with blackish-purple, smooth but dull, about 2.3 mm. long.—Collections: 14 (iii); representative: *Hitchcock & Muhlick 8895* (CAS, WS, WTU), *11,107* (CAS, NY, RSA, WS); *Christ 15,993* (NY, RSA); *Ripley & Barneby 8868* (CAS, NY, RM, RSA, UTC, WTU); *Rydberg 2703* (NY); *L. Williams 690* (CAS, NY).

Stony or grassy hillsides, talus, and rocky benchlands, often in sagebrush, on limestone (or reportedly on rhyolite), 5300–10,300 feet, locally plentiful in the valleys of the Beaverhead River and Red Rock Creek in southwest Montana, south to the Pahsimeroi and Big Lost Rivers in Custer County, Idaho, south and east, becoming rare and local, along the upper Snake River from near Pocatello to the foothills of the Grand Tetons in Teton County, Wyoming.—Map. No. 64—June to August, the fruit long persisting.

ASTRAGALUS TERMINALIS (of the railhead) Wats. in Proc. Amer. Acad. 17: 370. 1882.—"Southern Montana, on the gravelly bank of Red Rock Creek, in July, 1880, near the then terminus of the Utah and Northern Railroad; S. Watson."—Holotypus, GH! isotypus *(Watson 87)*, K!—*Tium terminale* (Wats.) Rydb. in N. Amer. Fl. 24: 393. 1929.

Astragalus reventoides (resembling *A. reventus*) Jones in Proc. Calif. Acad. Sci. II, 5: 661. 1895.—"Tweedy, No. 7, dry sagebrush areas, Grasshopper Creek, Beaver Head County, Montana, 5000° alt., August, 1888."—Holotypus, US!—*Cnemidophacos reventoides* (Jones) Rydb. in Bull. Torr. Club 40: 52. 1913. *A. terminalis* var. *reventoides* (Jones) Jones, Rev. Astrag. 167, Pl. 39. 1923.

The railhead milk-vetch is a rather variable species, especially in size of the flowers. These seem to become smaller in the mountains (as on Antelope Pass in Custer County), where the whole plant tends to become more thrifty and of lower stature, sometimes appearing acaulescent to the casual glance although never truly stemless. In the valleys and on protected banks in canyons *A. terminalis* is a handsome plant when in flower, with its neat, silvery foliage and rather closely flowered racemes of white or occasionally bluish-tinged flowers variegated by a prominently maculate keel-tip; but even in such sites the stems seldom surpass in length the first and longest inflorescence as measured from the fulcrant leaf to the last flower. The pod varies in outline from ovate-oblong to narrowly oblong, and the leaflets from obcordate to narrowly elliptic. These features are not correlated, however, and the admittedly "poor variety" *reventoides* (Jones, l. c.) characterized by relatively broad pod and leaflets seems to be no more than a minor individual variant.

The epithet *reventoides* was well chosen, for *A. terminalis* is no doubt related to *A. reventus* and may be described as a slender version of it, differing in its few leaflets, short calyx-teeth, and smaller, although similarly fashioned pod; and further notable among the *Reventi-arrecti* for its dense vesture of dolabriform hairs. First placed in *Cnemidophacos,* it was later transferred by Rydberg to *Tium,* where it was associated in sect. *Arrecta* with several of the bilocular *Reventi-arrecti.* On account of the lateral hair-attachment Jones (1923, p. 167) referred *A. terminalis* to his sect. *Uliginosi,* from which it differs importantly in its determinate, non-stoloniferous root-crown and free stipules. I have no doubt that Rydberg's estimate of its affinities was the more nearly correct. The railhead milk-vetch was first collected June 10 and 12, 1860, in Jackson's Hole, Wyoming, by F. V. Hayden.

XLII (iii). Subsectio ARRECTI

Vesture basifixed; *leaflets* mostly 21–33; *flowers* rather small, greenish-white or ochroleucous, the petals irregularly graduated, the banner ± 10–14 mm. long, gently incurved through ± 45° to a point just below the apex, the margin there abruptly folded backward, often splitting in age, ± 1–4 mm. shorter than the exserted wings, ± equaling or scarcely longer than the keel; *pod* erect, stipitate or sessile, uni- or bilocular, the oblong or oblong-ellipsoid body either glabrous or pubescent.—Spp. 2, of the palouse country of southeastern Washington and west-central Idaho.

ASTRAGALUS sect. REVENTI-ARRECTI subsect. ARRECTI Jones, Rev. Astrag. 159, in clave. 1929.—Sp. typica: *A. arrectus* Gray.—*Tium* sect. *Arrecta* Rydb. in N. Amer. Fl. 24: 390. 1929, pro parte, exclus spp. plur.

Key to the Species of Subsect. Arrecti

1. Pod sessile, glabrous; *banner* 11.5–14 mm. long; *calyx* ± 7–10.5 mm. long, the teeth 2–5 mm. long, the whole becoming fragile, circumscissile, leaving the ripe fruit naked ..... 159. *A. riparius*
1. Pod stipitate, pubescent; *banner* ± 10–11 mm. long; *calyx* ± 5–6.5 mm. long, its teeth less than 2 mm. long, the whole becoming papery but persistent unruptured about the stipe ..... 160. *A. arrectus*

159. Astragalus riparius

Commonly stout, sometimes quite slender, with a woody taproot and knotty, closely or loosely forking caudex, densely to rather thinly strigose-pilosulous with fine, nearly always straight, appressed or narrowly ascending hairs up to 0.45–0.6 (0.75) mm. long, the herbage cinereous or greenish, the leaflets glabrous above, the inflorescence nigrescent; *stems* several, erect or narrowly ascending in tufted clumps, 3.5–15 (19) cm. long, composed of 2–5 (6) developed internodes (the longest, usually that immediately preceding the first peduncle, up to 1.5–9 cm. long), the main axis less than half the height of the whole plant; *stipules* 2.5–7 mm. long, membranous, at first purplish- or greenish-tinged, becoming papery-scarious and fragile in age, triangular or lance-acuminate, the lowest broader, shorter, and more obtuse than the rest, all rather strongly adnate to the petiole-base, decurrent around half, or the lowest more than half the stem's circumference, their margins commonly beset with a few minute peg- or tack-shaped processes; *leaves* (5) 10–21 cm. long, with slender but rather stiff, often basally subpersistent petioles and 21–33 linear-oblong, -oblanceolate, or narrowly lance-oblong, mostly obtuse or truncate-emarginate, sometimes subacute, flat, folded, or involute leaflets (2) 4–21 mm. long, deciduous in age; *peduncles* stiffly erect (unless weighed down by the heavy fruit), stout, striate, 1.4–3 dm. long, nearly always much longer than the leaves; *racemes* (8) 12–21-flowered, at first anthesis rather dense but early loosening, the flowers loosely spreading or horizontal in age, the axis 4–12 cm. long in fruit; *bracts* membranous, lanceolate or ovate, 1.2–7.5 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 0.7–1.2 mm., in fruit greatly thickened, usually clavate, 2–5 mm. long; *bracteoles* commonly 2, often minute and scalelike, sometimes 0; *calyx* (6.9) 7.6–10.6 mm. long, strigose-pilosulous with black or fuscous hairs, the slightly oblique disc 0.8–1.4 mm. deep, the membranous, pallid, campanulate tube 4.6–5.8 mm. long, (3.3) 3.6–5 mm. in diameter, the lance-subulate teeth (1.9) 2.2–5.2 mm. long, the ventral pair commonly a little shorter than the rest, the whole becoming papery-scarious and (sometimes only tardily) circumscissile; *petals* greenish-white or cream-color, drying yellowish; *banner* ovate-cuneate or rhombic-obovate, (11.2) 11.5–14.1 mm. long, 5.5–8.2 mm. wide; *wings* 1–3 (4) mm. longer, 12.8–17 mm. long, the claws (4.4) 5.8–7.8 mm., the oblanceolate, half-elliptic, or rarely linear-oblong, obtuse or erose, slightly incurved blades 7.8–11 mm. long, (2.4) 3–4 mm. wide; *keel* (9.4) 10.2–12.8 mm. long, the claws (4.7) 5.2–7.2 mm., the obliquely triangular blades 4.9–6.5 mm. long, (2.6) 2.9–3.7 mm. wide, abruptly incurved through 90–95° to the bluntly or sometimes sharply deltoid apex; *anthers* (0.55) 0.6–0.85 mm. long; *pod* erect, sessile, obliquely oblong- or narrowly ovate-ellipsoid, (1.5) 1.7–2.5 cm. long, (5.5) 6.5–10 mm. in diameter, straight or a little incurved, broadly rounded or truncate at base, rather abruptly contracted distally into a deltoid- or triangular-acuminate, slightly compressed, rigidly cuspidate beak, otherwise obcompressed, bicarinate by the broad, obtuse, cordlike ventral and narrower, often undulate dorsal sutures, the ventral face flat or low-convex, the dorsal face flat or shallowly depressed, the green, fleshy, glabrous valves becoming rigidly leathery or woody, brown or stramineous, rugulose-reticulate and often wrinkled lengthwise, not inflexed or obscurely so, the rudimentary septum up to 0.6 mm. wide; *ovules* 23–28; *seeds* brown or black, smooth but dull, about 2.6 mm. long.—Collections: 17 (o); representative: *St. John 5933* (NY, WS); *W. A. Weber 2093* (WS, WTU); *MacDougal & Leiberg 135* (CAS, NY, UTC, WS); *A. & G. Heller 3066* (ND, NY, WS); *Head 473* (RSA).

Dry bluffs and canyon banks, 700–1700 feet, locally plentiful along the lower Snake River and its affluent creeks from the mouth of the Clearwater downstream

to that of the Tucannon River in Nez Perce County, Idaho and Whitman and Columbia Counties, Washington.—Map No. 63.—April to June, the fruit persisting till fall or winter.

ASTRAGALUS RIPARIUS (frequenting river banks) Barneby in Amer. Midl. Nat. 55: 490. 1956.—"WASHINGTON: Wawawai, Whitman Co., May 31, 1903, *C. V. Piper* No. 4133 . . ."—Holotypus, WS!

The most remarkable feature of *A. riparius,* which might well be known as the Piper milk-vetch, is the extraordinary fidelity with which it combines the sessile, unilocular, glabrous fruit of *A. reventus* with the uniquely modified flower of *A. arrectus;* I have already suggested that it may have arisen in the first place as a chance inter-specific cross. At present *A. riparius* is unquestionably self-perpetuating—there are records from Wawawai made at intervals over a lapse of nearly sixty years; and while there is no experimental evidence bearing on its origin, the dispersal patterns of the three entities are not opposed to the hybrid hypothesis. It will be recalled that *A. reventus* is a montane species of the timber belt in the Blue Mountains, reaching its northern limit near the head of the Tucannon River in Columbia County. By contrast *A. arrectus* is nearly endemic to the rolling hill country in southeast Washington and adjoining Idaho, where the original climax vegetation was dominated by sagebrush and bunchgrass, and finds its southern limit along and just to the north of the lower Clearwater and Snake Rivers westward into Whitman County. It is just south of this line, extending from near the mouth of the Clearwater west, always closely following the canyon of the Snake, to the mouth of the Tucannon River, that *A. riparius* possesses its peculiar ecological niche at the lowest elevations possible in the region. It has since occurred to me that *A. Sheldoni,* here interpreted as most closely related to *A. reventus,* having very nearly the latter's flower together with a narrower, semibilocular, often (even though only shortly) stipitate, commonly pubescent fruit, might be described as presenting a different mixture of the same set of characters. Perhaps significantly, certainly suggestively, *A. Sheldoni* is found in a small area close to the three already mentioned, at low and moderate elevations around the point on the Snake River common to Washington, Oregon, and Idaho. The nature of the relationship between these four astragali deserves careful investigation.

The Piper milk-vetch is a rather handsome plant, easily recognized when in flower by the proportionately short banner, which is only gently recurved below its abruptly replicate and easily lacerate distal margin and surpassed by the prominently exserted wings. The characteristic growth-habit, with stems short in proportion to the tall, sometimes apparently (but not truly) scapose peduncles is like that of *A. reventus* and the related sect. *Conjuncti.* The sessile, glabrous, unilocular fruit of fleshy, ultimately subligneous texture is diagnostic within the narrow known range of the species.

160. ASTRAGALUS ARRECTUS

Erect, rather robust, with a woody taproot and shortly forking or knotty root-crown, strigulose-pilosulous nearly throughout with fine, usually loosely ascending and incurved, or straight and appressed to subappressed hairs up to (0.4) 0.5–0.75 mm. long, the herbage green or subcinereous, the leaflets glabrous above, the inflorescence more or less black-hairy; *stems* several or numerous, erect and stiffly ascending in clumps, stout, striate, 2–4 dm. long, composed of some 4–6 developed internodes, that preceding the first peduncle usually much the longest and up to 9–20 cm. long, the main axis abruptly inhibited beyond the second (or third) peduncle and usually forming less than half the height of the mature plant; *stipules* membranous becoming papery-scarious, 4–8 mm. long, the lowest ovate, obtuse, the upper ones lanceolate or triangular-acuminate, all rather strongly adnate to the petiole-base, decurrent around half, or the lowest more than half the stems circumference, the margins beset with a few minute tack-shaped processes; *leaves* (6) 9–22 cm. long, the upper cauline ones very shortly petioled, with (17) 21–31 linear-oblong, narrowly oblong-elliptic, lanceolate, or (rarely, only in some lower leaves) oval, obtuse, truncate, or deeply notched, nearly flat, rather scattered leaflets (3) 8–22 mm. long; *peduncles* stiffly erect, stout, striate, often appearing as a continuation of the stem, 1–2.5 (3) dm. long, greatly surpassing the leaves; *racemes* 15–33-flowered, at early anthesis rather dense but early loosening, the

flowers ascending, the axis becoming 8–22 cm. long in fruit; *bracts* submembranous, triangular-lanceolate, 1.7–2.5 mm. long; *pedicels* straight, ascending, at anthesis 0.5–1.2 mm. long, in fruit clavately thickened, 1.5–3 (4) mm. long; *calyx* 5–6.3 mm. long, loosely strigulose or pilosulous with black, fuscous, or sometimes a few intermingled white hairs, the subsymmetric disc 0.7–1.2 mm. deep, the campanulate tube 3.7–4.7 mm. long, 3.1–4 mm. in diameter, the triangular-subulate teeth 1.3–1.8 mm. long, the ventral pair shorter and broader than the rest, the orifice somewhat oblique; *petals* ochroleucous, drying yellowish; *banner* ovate-cuneate, shallowly notched, 10–10.7 mm. long, 6.1–8 mm. wide; *wings* 12.3–13 mm. long, the claws 5.1–6.1 mm., the oblanceolate or obovate, obtuse, nearly straight blades 7.6–8.1 mm. long, 2.6–3.2 mm. wide; *keel* 10.1–10.6 mm. long, the claws 5.5–5.9 mm., the obliquely triangular blades 5.1–5.4 mm. long, 2.5–3.2 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid apex; *anthers* 0.55–0.7 mm. long; *pod* erect, stipitate, the straight stipe (2.5) 3–6 mm. long, the narrowly oblong-ellipsoid body (1.5) 1.7–2.3 cm. long, 4.5–6.3 mm. in diameter, straight or a trifle in- or decurved, cuneate to broadly rounded at base, abruptly contracted distally into a short, triangular-acuminate, laterally compressed, rigidly cuspidate beak, otherwise obcompressed, the low-convex or nearly flat ventral face carinate by the prominent, thick suture, the dorsal face openly but deeply grooved, the lateral angles rounded, the more or less fleshy, green valves becoming brownish-stramineous, stiffly leathery, rugulose-reticulate, loosely strigulose or pilosulous with straight and subappressed, or sometimes incumbent and subsinuous, black, white, or mixed hairs up to 0.3–0.5 mm. long, inflexed as a narrow but often nearly complete septum 0.5–0.9 mm. wide; *ovules* 18–26; *seeds* (seldom seen) brown or black, apparently smooth but dull, ± 2.2 mm. long.—Collections: 24 (o); representative: *Sandberg, MacDougal & Leiberg 135* (or *135a)* (CAS, NY, WS); *Christ 3944* (ID, NY); *W. H. Baker 7420* (ID, RSA); *Elmer 288* (MO, ND, NY); *Eggleston 21,969* (NY).

Grassy hillsides, sagebrush slopes and river bluffs, sometimes in openings of yellow pine forest, 1300–2600 feet, local but locally common in the rolling hill country about the lower Snake, Clearwater, and Palouse Rivers in Latah and Nez Perce Counties, Idaho, and Whitman County, Washington; also, perhaps disjunctly, along the lower Spokane and adjoining Columbia Rivers in the Grand Coulee region of Lincoln County, Washington.—Map No. 63.—Mid-April to July, the fruit long persisting.

ASTRAGALUS ARRECTUS (upright, of the pod) Gray in Proc. Amer. Acad. 8: 289. 1870.—"Kooskooskee River, coll. Geyer." [or *fide* Hook. in Lond. Jour. Bot. 6: 211. 1847, sub nomine *A. leucophyllo* T. & G. (non Willd.): "on layers of stiff, ferruginous clay-banks on the Trappe Mountain declivities; upper Kooskooskie. May (no. 378)."]— Holotypus, K! isotypi, BM, G, GH (fragm.), OXF!—*Phaca arrecta* (Gray) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 371. 1906. *Tium arrectum* (Gray) Rydb. in Bull. Torr. Club 40: 49. 1913.

Astragalus palousensis (of Palouse River) Piper in Bot Gaz. 22: 489. 1896.—"Common on rich loess hillsides about Pullman."—Holotypus, collected by A. D. E. Elmer at Pullman, Washington, July, 1896, US! paratypi, *Piper 1493,* NY, WIS, WS, WTU!—*A. arrectus* var. *palousensis* (Piper) Jones, Contrib. West. Bot. 10: 68. 1902.

The Palouse milk-vetch, *A. arrectus,* is most easily recognized by its irregularly proportioned flowers which ascend from the raceme-axis at an angle of about 45° and are followed by erect, stipitate, dorsally grooved pods of thick texture, pubescent with black or fuscous, rarely white hairs. The pod resembles that of *A. Leibergi* in shape and leathery texture, but the latter species has nodding flowers, regularly graduated petals, and the connately sheathing stipules of sect. *Conjuncti.* The common fate of *A. arrectus* has been confusion with *A. atropubescens* (Jones, 1923, p. 161, in part, Pl. 37, where the two entities are clearly distinguished but under the wrong names; Rydberg, 1929 p. 391 & 1931, p. 401). The pod of *A. atropubescens* is similar in form but of somewhat narrower and more slender profile, of thinner texture, and only rarely and then minutely strigulose. The species differs further from *A.*

arrectus in its nodding flowers with wings intermediate in length between the banner and keel; and except for some isolated stations in the Grand Canyon of the Snake and the lower Salmon Rivers, its range of dispersal lies well to the east of *A. arrectus* at elevations mostly above 4000 feet. At the time of my revision of this immediate group (1956, p. 491) I had not seen authentic material of *A. arrectus;* but relying on Hooker's description of the pod of *Geyer 378* as glabrous and the indication of a type-locality on the upper Clearwater River, I tentatively but mistakenly assigned the epithet *arrectus* to *A. atropubescens.*

The main range of *A. arrectus* is far from extensive, reaching only from the confluence of Lolo Creek with the Clearwater River in Idaho northwest to the neighborhood of Colfax in Whitman County, Washington, a distance of some 65 miles. The known stations in the Columbia Valley in Lincoln County lie farther distant over one hundred miles and no intermediate stations are yet on record.

XLII (iv). Subsectio Eremitici

Vesture basifixed; *leaflets* 11–29; *flowers* (nodding, spreading or ascending at full anthesis) small or moderate-sized, the banner 10.5–20.5 mm. long, variable in color, ochroleucous or less often pink-purple with contrasting paler wing-tips, the petals regularly even if only slightly graduated; *pod* erect or incurved through the stipe to bring the body to vertical, stipitate, the stipe usually as long or much longer than the calyx-tube, the body triquetrously or dorsiventrally compressed, bi- or subbilocular, the valves leathery or papery.—Spp. 4, of western Montana and central Idaho to northcentral Arizona and southern Nevada.

Astragalus sect. Reventi-arrecti subsect. Eremitici, subsect. nov., a *Reventis-arrectis* genuinis praesertim legumine longe stipitato, ab *Arrectis* petalis graduatis (vexillo leviter arcuato alas superanti nec multo breviori apicem versus abrupte retroplicato) absimiles.—Sp. typica: *A. eremiticus* Sheld.—*Astragalus* sect. *Reventi-arrecti* subsect. *Arrecti* Jones, Rev. Astrag. 159. in clave. 1923, pro parte, exclus. *A. arrecto* vero. *Tium* sect. *Arrecta* Rydb. in N. Amer. Fl. 24: 390, pro parte. 1929.

Key to the Species of Subsect. Eremitici

1. Stipe of the pod (2.5–7 mm. long) straight, erect in the same plane as the body and the pedicel, the pod thus appressed or approximate to the raceme-axis and the fruiting raceme strict and narrow (2)
   2. Body of the pod obtusely triquetrous with convex lateral and grooved but not or scarcely narrower dorsal faces; *flowers* nodding at full anthesis; *leaflets* 19–29; *ovules* 20–29; s.-w. Montana to centr. Idaho ..... 161. *A. atropubescens*
   2. Body of the pod compressed-triquetrous, with almost flat lateral and narrower, grooved dorsal faces; *flowers* ascending; *leaflets* 9–19 (21); *ovules* 16–18; Charleston Mountains, s. Nevada ..... 162. *A. remotus*
1. Stipe of the pod (6–18 mm. long) incurved from the spreading pedicel to bring the body erect parallel to but distant from the raceme-axis, the fruiting raceme thus broader and looser (3)
   3. Body of the pod cuneate at base, 3.5–7.5, more rarely (s.-ward) up to 9 mm. in diameter, grooved dorsally, keeled ventrally by the salient suture, the cross-section obcordate, the septum 0.5–1.2 mm. wide; Idaho s.-w. from the Sawtooth Mountains to s.-e. Oregon, s.-w. Utah, and n.-centr. Arizona ..... 163. *A. eremiticus*
   3. Body of the pod truncate at base, 6.5–10 mm. in diameter, openly grooved along both sutures, the cross-section subdidymous, the septum 1.4–1.8 mm. wide; both slopes of the Bitterroot Mountains, e.-centr. Idaho and adjoining Montana ..... 164. *A. scaphoides*

161. Astragalus atropubescens

Slender but often rather tall, with a woody taproot and knotty or shortly forking caudex, strigulose nearly throughout with fine, appressed and subappressed, straight hairs up to 0.3–0.6 mm. long, the herbage commonly green, the growing tips sometimes cinereous, the leaflets glabrous above; *stems* several or numerous, erect and ascending in clumps, (1) 1.5–3 (4) dm. long, simple or bearing 1–2 branches or spurs at the middle nodes, the main axis composed of about 4–8 developed internodes and (except in dwarfed or immature plants) forming at least half and usually more than half the total height; *stipules* 2.5–6 mm. long,

the lowest ones papery, amplexicaul-decurrent around ¾ to nearly the whole stem's circumference, the median and upper ones narrower, ovate or triangular, with erect or deflexed, commonly subherbaceous blades, the margins rarely beset with a few minute processes; *leaves* 5–21 cm. long, all petioled but the uppermost quite shortly so, with (15) 19–27 (29) oblong, oblong-oblanceolate, or linear-oblong, mostly truncate or retuse, in the upper leaves sometimes linear and mucronulate, flat or loosely folded leaflets 5–25 mm. long; *peduncles* erect, 8–20 (25) cm. long, usually longer than the leaf; *racemes* loosely 10–20 (25)-flowered, the flowers nodding at anthesis, the axis early elongating, (3) 5–27 cm. long in fruit; *bracts* membranous, ovate or lance-acuminate, 1.5–3.5 mm. long; *pedicels* at anthesis slender, arcuate, 0.7–1.5 (1.9) mm. long, in fruit erect or narrowly ascending, straight or nearly so, clavately thickened, 2.4–4 mm. long; *bracteoles* usually present, commonly minute, sometimes 0; *calyx* 5.1–6.6 mm. long, thinly to quite densely strigulose with black or largely black hairs, the subsymmetric disc 0.8–1.4 mm. deep, the campanulate tube 3.8–4.9 mm. long, 2.8–3.5 (3.8) mm. in diameter, the triangular-subulate teeth 1–1.9 mm. long, the ventral pair usually broader and a trifle shorter than the rest, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* white or cream-colored, immaculate, drying ochroleucous; *banner* at first gently recurved through ± 45°, ultimately through nearly 90°, rhombic-elliptic or -ovate, shallowly notched, 13–15.5 (17.6) mm. long, 6–7.4 mm. wide; *wings* 11.6–14.2 (16) mm. long, the claws 5.1–6.5 mm., the obliquely oblanceolate, shallowly emarginate or obtuse, gently incurved blades 7.1–9.5 (10.4) mm. long, (2.5) 2.8–3.3 mm. wide; *keel* 10.2–11.8 (12.5) mm. long, the claws 4.9–6.3 (6.7) mm., the half-obovate blades 5.1–6.2 (6.5) mm. long, 2.6–3.2 mm. wide, abruptly incurved through 90° to the bluntly deltoid apex; *anthers* 0.5–0.7 mm. long; *pod* stiffly erect, stipitate, the stipe (2.5) 3–6 mm. long, the linear-oblong or (when relatively short) narrowly oblong-ellipsoid, essentially straight body 1.4–2.4 (2.8) cm. long, 2.7–4.5 mm. in diameter, broadly cuneate or sometimes tapering at base, contracted distally into a short, triangular-acuminate, laterally compressed, rigidly cuspidate beak, otherwise obtusely triquetrous with convex lateral and shallowly grooved dorsal faces, keeled ventrally by the prominent, thick, concolorous or purplish suture, the firm but scarcely fleshy valves becoming leathery, greenish-stramineous, transversely impressed-reticulate, commonly glabrous but sometimes minutely strigulose with black or some white hairs, inflexed as a partial or nearly complete septum 0.8–1.7 mm. wide; *ovules* 20–29; *seeds* brown or black, smooth but dull (seldom observed), 2.2–2.8 mm. long.—Collections: 26 (iv); representative: *C. L. Hitchcock 15,738* (NY, RSA, WS); *Hitchcock & Muhlick 9513* (NY, RSA, WS), *14,279* (CAS, NY, RSA, WS); *Ripley & Barneby 8130* (CAS, RSA, UTC), *10,719* (CAS, RSA); *Constance, Rollins & Dillon 1601* (WS, WTU).

Gravelly or sandy flats, benches, and hillsides, commonly among sagebrush, on granitic or basaltic (rarely calcareous or shaley) bedrock, widely dispersed and locally common between 3900 and 8000 feet in the valleys and mountains of eastcentral Idaho, especially on the upper Salmon River and its tributaries, extending north to the Big Hole and headwaters of Clark's Fork in western Montana and east just across the Continental Divide to the Missouri Valley at Helena; also locally, on steep grassy banks, 1250–1800 feet, in the canyons of the Salmon and adjoining Snake Rivers in Idaho County, Idaho.—Map No. 64. —May to July (flowering in April in Idaho County), the fruit persisting into fall.

ASTRAGALUS ATROPUBESCENS (black-hairy) Coult. & Fish. in Bot. Gaz. 18: 300. 1893.—"Deer Lodge, Montana, June, 1892, F. D. Kelsey."—Holotypus not located; isotypi, NY, OB,

RSA, US (fragm.).—*Tium atropubescens* (Coult. & Fish.) Rydb. in Bull. Torr. Club 40: 49. 1913.

Astragalus Kelseyi (Rev. Francis Duncan Kelsey, 1849–1905, sometime pastor at Helena, Montana, amateur botanist and afterward professor of botany at OB) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 241. 1900—"Montana; Deer Lodge, 1892, *F. D. Kelsey;* Beaverhead County, 1888, *Tweedy 8.*"—Holotypus (an isotypus of *A. atropubescens*), collected June 9, 1882, and paratypus *(Tweedy),* NY!—*A. arrectus* var. *Kelseyi* (Rydb.) Jones, Rev. Astrag. 161. 1923, quoad nom., non descr.

The Kelsey milk-vetch, *A. atropubescens,* is a graceful, rather slender astragalus resembling *A. filipes* when in flower, but easily distinguished at that stage of growth by the free lower stipules, and subsequently by the erect, trigonously compressed, almost fully bilocular fruit. In western Montana, in Idaho along the upper Salmon above Challis, and thence south to the head of the Lost River, the pod of *A. atropubescens* is consistently glabrous; and the same is true of the disjunct populations in western Idaho County. A form with pod minutely strigulose with black or fuscous (rarely white) hairs represents the species in a small area along the middle Salmon River from a point about midway between Challis and the town of Salmon, whence it has been traced upstream along the Pahsimeroi to Tendoy (cf. *Macbride & Payson 1882,* CAS, NY; *Hitchcock & Muhlick 9031,* CAS, NY, UTC, WS, WTU; *Ripley & Barneby 8854,* CAS, NY, RSA). Because of exaggerated emphasis on the pod's vesture, this interesting but minor variant has often been confused with *A. arrectus;* a glance, however, at the very different flowers is enough to distinguish them. Thus the flower described for *A. arrectus* by Jones (1923, p. 161) is correct for the species here treated under that name, but the "smooth" (meaning glabrous) pod is that of the Kelsey milk-vetch which Jones seems to have interpreted as a form of *A. arrectus* with "produced banner" native to Deer Lodge Valley. The differences in attitude and proportions of the two different flowers are clearly illustrated on Plate 37 of the *Revision of Astragalus.* Rydberg's *Tium arrectum,* as defined by specimens annotated in his hand, is largely genuine *A. arrectus* but contained elements of *A. atropubescens* (some from Salmon and Anaconda also cited by Rydberg, 1931, p. 401). The independent descriptions of *A. atropubescens* and *A. Kelseyi* from duplicates of the same collection can be attributed in some measure to the apparent loss of the genuine species in the shadow of the better known *A. arrectus* (or *A. palousensis*). Jones's transfer of the epithet *Kelseyi* (1923, p. 161) to replace his own earlier combination *A. arrectus* var. *spencianus* is difficult to understand, for the range of dispersal of genuine var. *spencianus,* which does not extend north of the Sawtooth Range in Idaho, was already pretty well established. The present record of *A. atropubescens* from Helena is derived from a collection, so labeled but lacking date or other data, in Kelsey's own herbarium (OB). We have no modern knowledge of *A. atropubescens* in the Missouri Valley, and the chance of error cannot be overlooked.

It is possible that the name *A. atropubescens* should be superseded by *A. stenophyllus* T. & G., a name based on controversial (because young and incomplete) specimens collected somewhere in western Montana or adjoining Idaho. This point is discussed in detail under *A. (Cusickiani) filipes,* the species to which the majority of botanists have applied what I can only call a nomen ambiguum.

162. Astragalus remotus

Slender, sparsely leafy, with a taproot and shortly forking, at length suffruticulose caudex, thinly strigulose nearly throughout with appressed, somewhat flattened hairs up to 0.3–0.45 mm. long, the stems commonly cinereous toward the base, the herbage greenish, the leaflets glabrous above; *stems* several or numerous, erect and stiffly ascending in clumps, 1.5–4 dm. long, with up to 8 developed internodes 1–10 cm. long, simple or bearing 1–2 branches from near or below the middle; *stipules* 2–4 (6) mm. long, the lowest deltoid or ovate, early becoming papery-scarious, decurrent around half to nearly the whole stem's circumference, the median and upper ones narrower, subherbaceous, with deltoid-acuminate, often reflexed blades; *leaves* 4–15 (18) cm. long, all petioled, with slender rachis and 11–19 (21) distant, linear-oblong, narrowly oblong-oblanceolate, or obovate, obtuse, subtruncate, or shallowly retuse, flat or folded leaflets 2–13 mm. long; *peduncles* stiffly erect, 6–17 (24) cm. long, longer than the leaf; *racemes* loosely or remotely (5) 8–15-flowered, the flowers ascending at anthesis, the axis (3) 5–15 cm. long in fruit; *bracts* membranous, ovate-acuminate, 1.5–2.3 mm. long; *pedicels* straight, ascending, at anthesis 1–1.8 mm., in

fruit thickened, 1.5–2.8 mm. long; *bracteoles* 0; *calyx* 4.8–6.3 mm. long, strigulose with mostly black hairs, the subsymmetric disc 0.8–1 mm. deep, the campanulate tube 3.1–4.2 mm. long, 2.2–2.6 mm. in diameter, the subulate teeth 1.2–2.1 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, the keel-tip faintly lilac-tinged; *banner* gently recurved through ± 40°, subrhombic-ovate, shallowly notched, 10.5–13.8 mm. long, 5.4–6.4 mm. wide; *wings* 9.9–11.3 mm. long, the claws 4.2–5 mm., the oblong-oblanceolate, shallowly emarginate, slightly incurved blades 6.4–7.1 mm. long, 2.2–2.4 mm. wide; *keel* 8.5–9.6 mm. long, the claws 4–5 mm., the half-obovate blades 4.5–5 mm. long, 2.2–2.7 mm. wide, incurved through 90° to the bluntly deltoid apex; *anthers* 0.55–0.7 mm. long; *pod* stiffly erect, stipitate, the slender, straight stipe 3.5–7 mm. long, the body linear-oblong in profile, straight, cuneate at both ends, shortly cuspidate at apex, 1.5–3 cm. long, 2.7–4 mm. in diameter, compressed-triquetrous with nearly flat lateral and narrow, shallowly grooved dorsal faces, keeled ventrally by the prominent suture, the pale green or purplish, glabrous, thin-textured valves becoming papery, stramineous, finely reticulate, inflexed as a nearly complete septum 1–2 mm. wide; *ovules* 16–18; *seeds* ± 2 mm. long, not seen fully ripe.—Collections: 9 (ii); representative: *Clokey & Anderson 7998* (CAS, NA, NY, RSA); *Clokey 8407* (CAS, NA, NY, WS), *8714* (NA, NY, OB, SMU, TEX, WIS, WS); *Maguire 18,067* (WS).

Rocky hillsides and canyon banks, in dry, gravelly soils derived from sandstone or limestone, 3600–5550 feet, locally plentiful but known only from the south base and foothills of the Spring and Charleston Mountains, Clark County, Nevada.—Map No. 65.—April to early June.

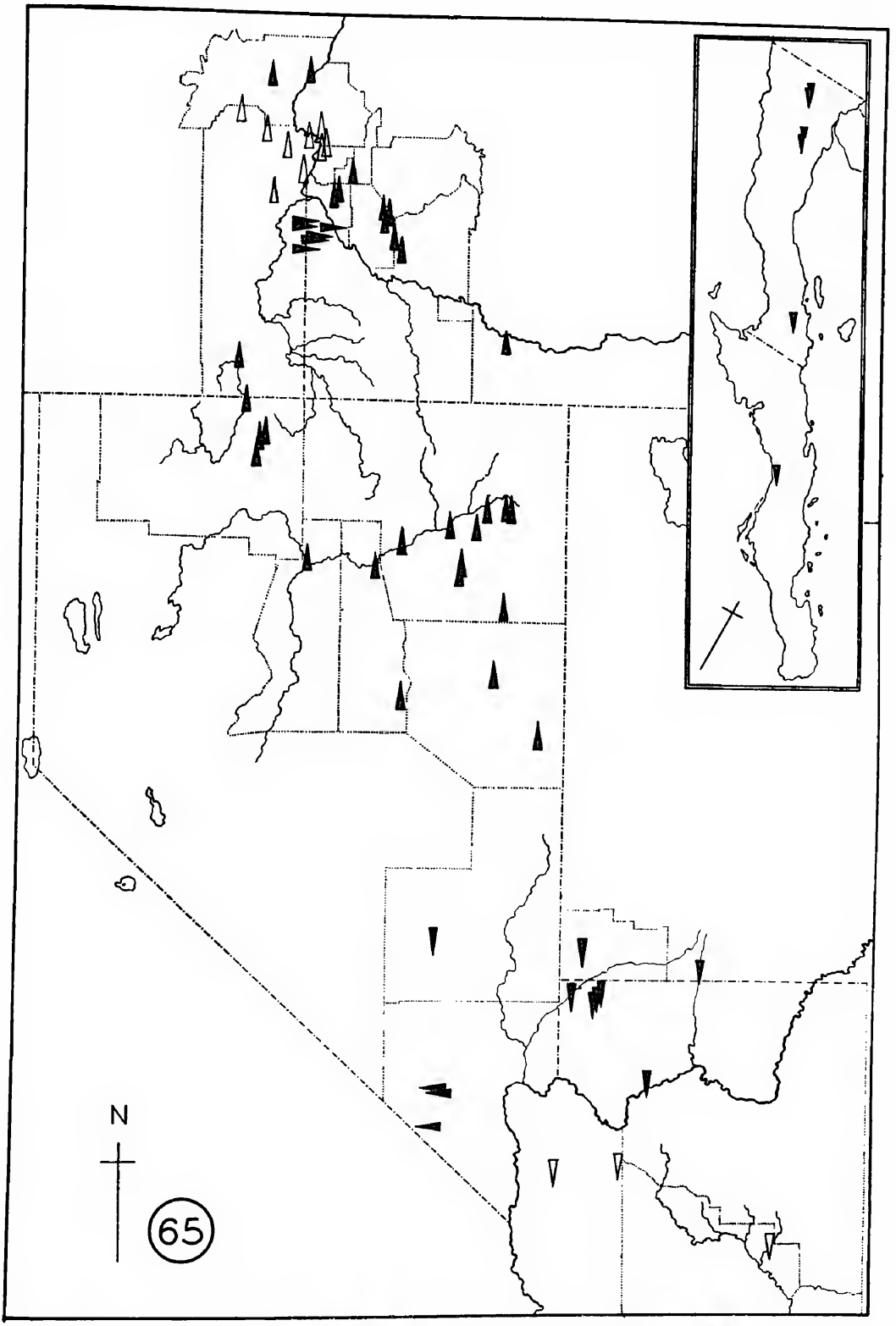
ASTRAGALUS REMOTUS (Jones) Barneby in Leafl. West. Bot. 4: 59. 1944, based on *A. arrectus* var. *remotus* (distant, of the flowers, pods, and leaflets) Jones, Rev. Astrag. 162, Pl. 38. 1923.—"... at Good Springs on the western edge of Nevada ..."—Holotypus, collected May 1, 1905, by M. E. Jones, POM!; isotypi, CAS, NY!—*Tium remotum* (Jones) Rydb. in N. Amer. Fl. 24: 391. 1929.

The Spring Mountain milk-vetch, *A. remotus,* is the smallest-flowered of the *Eremitici,* notable further for its ascending, remotely racemose flowers, and papery, strongly compressed pod. The flowers of typical *A. eremiticus,* which occurs at about the same latitude in southeastern Nevada and extends thence into Utah and Arizona, also ascend at anthesis; however they are not only larger (with banner at least 14.5 mm., keel at least 10.5 mm. long) but with rare exceptions bicolored, pink-purple except for the pallid wing-tips; moreover the spreading and incurved stipe is twice longer (7–15 mm.), and the pod-body of thicker texture, wider, and more trigonously than laterally compressed. These two southern members of the subsection have in common leaves composed of comparatively few leaflets but are otherwise sharply distinct, and no credence can be allowed to Jones's statement (1923, p. 163) about his unreasonably inclusive concept of *A. arrectus* that "all these forms intergrade from one to the other as you go south." Care should be taken to distinguish the Spring Mountain milk-vetch from *A. bernardinus,* a species extending eastward through the Mohave Desert nearly to the Nevada line. Superficially similar in some cases, it is easily recognized by its sharply and exactly triquetrous pod which disjoints from a stipelike gynophore, lilac-tinged flowers, and leaflets pubescent on both sides, commonly canescent above.

The known range of *A. remotus* extends from the type-locality in the Spring Mountains north to Rocky Gap and Cottonwood Springs in the south foothills of the Charleston Range, a distance of approximately thirty miles. Although so greatly restricted, it is far from rare on the sedimentary formations in the foothill canyons and is locally abundant in years of adequate rainfall.

163. ASTRAGALUS EREMITICUS

Of moderate stature, slender or quite stout, with a woody taproot and knotty root-crown or shortly forking caudex, densely to quite thinly strigulose with straight, appressed hairs up to 0.3–0.7 mm. long, the herbage green or cinereous, the leaflets commonly bicolored, of lighter and brighter green and commonly



Map No. 65. Nevada and parts of adjoining states. Range of *A. eremiticus*: minor variant No. 1; m. v. No. 2; m. v. No. 3; m. v. No. 4; m. v. No. 5; and of *A. remotus*. Inset, top right, Baja California. Range of *A. Orcuttianus*.

glabrous above; *stems* several, erect and ascending in clumps, more rarely ascending and diffuse, 1–5 dm. long, composed of ± 4–8 developed internodes, simple or spurred at 1–3 of the lower axils; *stipules* 3–11 mm. long, the lowest papery-scarious, often loosely imbricated, mostly ovate, amplexicaul-decurrent around half or more of the stem's circumference, the median and upper ones narrower, subherbaceous, with triangular or lanceolate, erect or recurved blades; *leaves* (3) 4.5–18 cm. long, the lower ones slender-petioled, the upper shortly so or subsessile, with 11–23 ovate, oblong, elliptic, or linear, obtuse or retuse, flat or folded leaflets 5–26 mm. long; *peduncles* erect, (1.5) 2.5–17 (24) cm. long, a little shorter or longer than the leaf; *racemes* (7) 10–26-flowered, either loose or compact at anthesis, the flowers ascending, spreading, or declined, the axis more or less elongating, (1.5) 2.5–18 cm. long in fruit; *bracts* membranous, ovate or lanceolate, 1.5–4 mm. long; *pedicels* at anthesis slender, 0.7–1.5 mm. long, in fruit thickened, 1.5–3.5 mm. long, spreading-ascending at an angle of ± 45°; *bracteoles* 0–2, commonly present; *calyx* 5.4–9.5 mm. long, strigulose with black or mixed black and white hairs, the subsymmetric or oblique disc 0.9–1.6 mm. deep, the deeply campanulate tube 4.4–8 mm. long, 2.2–4 mm. in diameter, the subulate teeth 1–2.6 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous immaculate, ochroleucous with maculate keel-tip, or pale and dull purple to bright pink-purple with contrasting white or pallid wing-tips; *banner* recurved through ± 45°, rhombic-obovate or -oblanceolate, 12–20 mm. long, 5.6–10 mm. wide; *wings* 10.2–18 mm. long, the claws 5.3–8.2 mm., the narrowly oblong-oblanceolate, obtuse or emarginate, straight or slightly incurved blades 6–9 mm. long, 1.8–3.1 mm. wide; *keel* 9.4–14.4 mm. long, the claws 5.4–8 mm., the half-elliptic blades 5–7.3 mm. long, gently incurved through ± 80 (90)° to the bluntly deltoid apex; *anthers* 0.55–0.75 (0.8) mm. long; *pod* stipitate, erect or exceptionally deflexed, the stipe usually incurved-ascending to bring the body to vertical, 6–15 mm. long, the body narrowly oblong-ellipsoid, solid or sometimes a trifle tumid, 1.5–2.7 (3) cm. long, 3.5–8 (9) mm. in diameter, cuneately contracted at base and tapering into the stipe, abruptly contracted distally into a short, triangular, laterally compressed, porrectly cuspidate beak, otherwise bluntly triquetrous and a little dorsiventrally compressed, with low-convex lateral and openly grooved dorsal faces, keeled ventrally by the prominent, often purplish suture, the slightly or decidedly fleshy, green or purple-suffused or -speckled, glabrous valves becoming thinly or stiffly leathery, reticulate, brownish-stramineous, inflexed as a complete or partial septum 0.5–1.2 mm. wide; *ovules* 17–32; *seeds* (little known) olivaceous, smooth or sparsely pitted, 2.8–3.2 mm. long.—Collections: 89 (x); representative materials cited in the discussion.

Open valleys, foothills, rolling plains, barren clay hills, and sandy or clayey bluffs and knolls, commonly among sagebrush or (southward) in piñon-juniper forest, 2100–6800 feet, on diverse soils (noted in more detail below), widespread and locally plentiful from the foothills bordering the lower Snake River Plains in southwestern Idaho (southern Washington to Twin Falls County) and southeastern Oregon (extreme southern Baker and Malheur Counties) south through eastern Nevada to the Colorado River, extreme southwestern Utah (Washington and Kane Counties) and northwestern Arizona (Mohave County, on both sides of the Colorado; one station on the upper Verde River in Yavapai County). —Map No. 65.—April to July, the fruit long persisting.

ASTRAGALUS EREMITICUS (dwelling hermitlike in desert on lonely places) Sheld. in Minn. Bot. Stud. 1: 161. 1894.—"Collected in the Beaverdam mountains, southern Utah, May, 1874, by Dr. C. C. Parry; also at Sprucemont, Nevada, July, 1891, by M. E. Jones . . . "—Holotypus

(*Parry 45*, from St. George), MINN! isotypi, GH, MO, NY, P!—*A. arrectus* var. *eremiticus* (Sheld.) Jones in Proc. Calif. Acad. Sci. II, 5: 665. 1895. *Tium eremiticum* (Sheld.) Rydb. in Bull. Torr. Club 40: 49. 1913. *A. eremiticus* var. *typicus* Barneby in Proc. Calif. Acad. Sci. IV, 25: 155. 1944.

Astragalus Cusickii Rydb. in Bull. Torr. Club 26: 541. 1899.—"Malheur, 1885, *W. C. Cusick 1238* . . . "—Holotypus, GH!—*A. malheurensis* (of Malheur, Oregon) A. Heller, Cat. N. Amer. Pl., Ed. 2, 7. 1900, a legitimate substitute (non *A. Cusickii* Gray, 1878). *Tium malheurense* (A. Heller) Rydb. in N. Amer. Fl. 24: 391. 1929. *A. eremiticus* var. *malheurensis* (A. Heller) Barneby in Amer. Midl. Nat. 41: 501. 1949.

Astragalus boiseanus (of Boise, Idaho) A. Nels. in Bot. Gaz. 53: 223. 1912.—"C. N. Woods, No. 4, Caldwell, Idaho, May 1910; Francis Macbride, No. 257, Boise Hills, June 18; No. 112 (type) Big Willow, May 27, 1910."—Holotypus, *Macbride 112*, RM! isotypi, GH, MO, NY, US, WIS! Paratypi, *Macbride 257*, MO, RM!—*Cystium boiseanum* (A. Nels.) Rydb. in Bull. Torr. Club 40: 50. 1913.

Astragalus eremiticus var. *spencianus* (of Spencemont, Nevada) Jones, Contrib. West. Bot. 10: 60. 1902.—" . . . the characteristic form of eastern Nevada . . . "—Lectotypus (Barneby 1944, p. 155), *Jones* (from Spencemont, Nevada) *in 1891*, POM!

The hermit milk-vetch, *A. eremiticus*, is a variable and perplexingly polymorphic species, composed of numerous races which I cannot for the present define in terms exact enough to serve taxonomic purposes. The variable features, variably correlated, are: density of vesture; width of leaflets with consequent alteration of the plant's gross aspect; length and openness of the raceme; orientation of the flower at anthesis (the calycine disc oblique when nodding, symmetric otherwise); width of calyx-tube; color and, to some degree, length of petals; width of pod; and in one rare instance orientation of the pod which is ordinarily held vertically erect on a slender, spreading and distally incurved stipe. The racial problem in *A. eremiticus* has engaged my attention over a number of years, and I have maintained in the past a glabrescent, broad-leaved var. *eremiticus* (or var. *typicus*, l.c.) with open racemes of ascending, purple or bicolored flowers ranging (mostly calciphile) from Lincoln County, Nevada, to northwestern Arizona and adjoining Utah; a var. *spencianus* differing in its more compact racemes of declined, whitish flowers dispersed from eastcentral Nevada north to the limit of the species; and a var. *malheurensis*, supposedly distinguished by its linear leaflets and often purple flowers (an inexact concept), thought to be endemic to southwestern Idaho and adjoining Oregon. The situation as I had projected it has been shown by recently acquired material to be more complicated than I had supposed, and it will be necessary to reassemble all available material at one place before the evidence can be re-evaluated. A review of more complete data may reveal the existence of five or more varieties, ecologically as well as morpholgically isolated. As a basis for further study, I present here a tentative key to what I am obliged to call minor variants, although at least some of them are almost certainly of a higher category.

1. Body of the pod erect on a spreading, distally incurved stipe; widespread, from Mohave County, Arizona, northward (2)
   2. Calyx-tube narrowly cylindric, 2.2–2.7 mm. in diameter; *flowers* ascending at anthesis (the calycine disc subsymmetric), relatively small, the keel 9.4–11 mm. long; *petals* ochroleucous with prominent purple keel-tip; *leaflets* linear, the widest on a plant 1–2.5 (3) mm. broad.—Hot, sandy bluffs and gullied clay hillsides or gravelly flats, mostly 2100–2500 feet, locally common along the Snake River and its immediate affluents in Washington and Payette Counties, Idaho, and adjoining Malheur County, Oregon. (*A. malheurensis* A. Hell.; *A. eremiticus* var. *malheurensis* Barneby, p. p.) = M. v. 5; collections: 9 (i); representative: *M. & G. Ownbey 2761* (CAS, NY, RSA, SMU, WS); *Peck 25,934, 25,936* (RSA); *J. & C. Christ, 17,281* (ID, NY, RSA). Intergrades with m. v. 3 & 4.
   2. Calyx-tube broader, (2.7) 3–3.8 (4) mm. in diameter; *flowers* mostly larger, the keel over 11.5 mm. long or, if shorter, then the petals purple; *petals* either ochroleucous and immaculate or bicolored, purple with pale wing-tips (3)
      3. Calycine disc subsymmetric, the flowers ascending in lax, distantly flowered racemes, the fruiting axis 5–17 cm. long in fruit; *pod* relatively thin-textured. Leaflets mostly ovate-oblong, the widest about 6–8 mm. broad, thinly pubescent beneath; *petals* bicolored, exceptionally ochroleucous, the keel 10.6–12.6 mm. long.—Low hills and open slopes in thin sagebrush or piñon-juniper forest, mostly on limestone, 3000–5550 feet, local, Muddy River Valley in Lincoln County, Nevada, east to the Virgin River in Washington County, Utah, south to Toroweap Point and Peach Springs near the Colorado River in Mohave County, Arizona. (*A. eremiticus*, sens. strict.) = M. v. 1; collec-

tions: 19 (iii); representative: *Ripley & Barneby 4313, 4408* (CAS, RSA); *Palmer 121 in 1877* (NY); *Jones 5003, 5070, 5071, 5082b* (all NY, POM).—Pod variable, sometimes decidedly tumid, 4–9 mm. in diameter.

3. Calycine disc strongly oblique, the tube more or less distended dorsally behind the pedicel, the flowers widely spreading or declined at anthesis, more compactly racemose, the inflorescence exserted just beyond the leaves, the axis 2.5–10 cm. long in fruit; eastcentral Nevada northward (4)

4. Petals purple or distally suffused with purple; *leaflets* narrowly oblong or linear-oblong, the widest 2.5–4 mm. broad, cinerous beneath. Keel 11.8–14.4 mm. long; *body* of the pod (3.5) 4–5.5 mm. in diameter.—Barren clay hills and gullied bluffs, often in thin sagebrush, 2500–4200 feet, locally common in a restricted area south of the Snake River in western Owyhee County, Idaho, and adjoining Malheur County, Oregon. (*A. eremiticus* var. *malheurensis* Barneby, p. p.) = M. v. 3; collections: 10 (i); representative: *Maguire & Holmgren 26,370* (NY, RSA); *Ripley & Barneby 6143* (CAS, GH, NY); *W. H. Baker 10,162* (ID, RSA).

4. Petals ochroleucous, immaculate; *leaflets* broader, the widest 5–8 mm. broad, variably pubescent but usually greenish beneath. Keel 11–14 mm. long; *body* of the pod 3.7–7 (7.5) mm. in diameter.—Open valleys, foothills, and rolling plains, in stiff clays or sandy alluvial soils derived from basalt, 2000–6800 feet, widespread and locally common from northeastern and northcentral Nevada, especially within the Humboldt River drainage, north to the lower Snake River Plains and surrounding foothills in southwestern Idaho and immediately adjoining Oregon. (*A. eremiticus* var. *spencianus* Jones; *A. boiseanus* A. Nels.) = M. v. 4; collections: 44 (v); representative: *Watson 264* (GH, NY, WS); *Macbride 821* (NY, SMU, WS); *Maguire & Holmgren 26,181* (NY, RSA); *M. & G. Ownbey 2818* (RSA, WS); *Holmgren 540* (NY, WS); *Eastwood & Howell 300, 329* (CAS).—The commonest form, apparently passing into M. v. 3 & 5 in southwestern Idaho and southeastern Oregon, but ordinarily well distinguished from M. v. 1 southward.

1. Body of the pod and the stipe deflexed, the body somewhat tumid, 6–9 mm. in diameter; Oak Creek, upper Verde River drainage, probably in volcanic soils, Yavapai County, Arizona. Racemes loose, the purple or "red-violet" flowers early nodding, the axis 9–12 cm. long in fruit; *leaflets* broadly obovate or rhombic-elliptic, retuse, 3–10 mm. wide; *calyx-tube* about 4 mm. in diameter, oblique at base. = M. v. 2; collections: 1 (*Cutler 4658*, NY, SMU, WS).—A peculiar plant, to be looked for further.

164. Astragalus scaphoides

Relatively stout, with a woody taproot and knotty, shortly forking caudex, strigulose with fine, mostly straight, appressed hairs, the herbage subcinereous when young, the leaflets bicolored, gray-green beneath, brighter green and glabrous above; *stems* several or numerous, erect and ascending in clumps, (1) 1.5–4 dm. long, simple or spurred below the middle, commonly purple-tinged, composed of about 4–8 developed internodes, that preceding the first peduncle usually the longest; *stipules* submembranous, early becoming papery, 3–8 mm. long, the lowest ovate, obtuse, semiamplexicaul-decurrent, the median and upper ones narrower, ovate-acuminate, deltoid, or broadly lanceolate, obtuse or acute; *leaves* (6) 8–20 (24) cm. long, all petioled but the upper ones shortly so, with (9) 17–25 oblong, elliptic, rhombic-ovate, or -lanceolate, or (in some upper leaves) linear-elliptic, obtuse or subacute, flat leaflets (7) 10–20 (28) mm. long; *peduncles* stout, stiffly erect, 8–16 cm. long; *racemes* (9) 15–30-flowered, the flowers widely spreading or loosely nodding, rather crowded at early anthesis, the axis soon elongating, (3) 5–17 cm. long in fruit; *bracts* membranous, lanceolate, 2–4.5 mm. long; *pedicels* at anthesis 1.5–2.5 mm. long, in fruit clavately thickened, straight or nearly so, ascending, 2.5–5 mm. long; *bracteoles* usually 2, attached at base of calyx or on the pedicel; *calyx* 9.6–12.2 mm. long, loosely strigose-pilosulous with black or black and white hairs, the strongly oblique disc

1.2–1.5 mm. deep, the subtumid, pallid, deeply campanulate tube 7–9 mm. long, 4.2–5 mm. in diameter, the lance-subulate teeth (1) 2–3.2 mm. long; *petals* ochroleucous, immaculate; *banner* recurved through ± 50°, rhombic-obovate or -oblanceolate, shallowly notched, 18.5–20.5 mm. long, 8–10 mm. wide; *wings* 16–17.4 mm. long, the claws 7.4–8.7 mm., the oblong-oblanceolate, obtuse, nearly straight or lunately incurved blades 8.4–10.1 mm. long, 2.8–3.3 mm. broad; *keel* 13–15 mm. long, the claws 7.5–9.1 mm., the half-obovate blades 5.5–7.3 mm. long, 3–3.2 mm. wide, abruptly incurved through 90° to the bluntly deltoid apex; *anthers* 0.55–0.75 mm. long; *pod* long-stipitate, the slender but rigid stipe 12–18 mm. long, ascending and incurved to bring the body to vertical, the subsymmetrically oblong- or ovoid-ellipsoid body moderately inflated, (1.1) 1.4–2.2 cm. long, (4.5) 6.5–10 mm. in diameter, straight or nearly so, truncate at base, abruptly contracted distally into a short, triangular, compressed, cuspidate beak, otherwise obcompressed, with openly and shallowly sulcate ventral and dorsal faces and broadly rounded lateral angles, the thinly fleshy, glabrous, green but commonly purple-suffused or -speckled valves becoming leathery, stramineous, reticulate, inflexed as a nearly complete or incomplete septum 1.4–1.8 mm. wide; *ovules* 21–32; *seeds* (not seen ripe) about 3 mm. long.—Collections: 7 (i); representative: *Hitchcock & Muhlick 9200, 9229* (NY, RSA, WS); *C. L. Hitchcock 15,799* (NY, DS, RSA, WS); *Ripley & Barneby 8855* (CAS, IDS, RM, RSA, UTC).

Open valleys, low hills, canyon benches, commonly among sagebrush, on either limestone or basalt, 3500–6000 feet, locally plentiful but of restricted range, known only from the foothills of the Bitterroot Mountains and immediately adjoining valleys of the upper Salmon and Lemhi Rivers in eastcentral Idaho and that of Red Rock Creek in western Beaverhead County, Montana.—Map No. 64.—June to early August.

ASTRAGALUS SCAPHOIDES (Jones) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 241. 1900 *("scophioides")*; Jones, Contrib. West. Bot. **10**: 69. 1902 *("scaphoides!")*, based on *A. arrectus* var. *scaphoides* (boat-shaped, of the pod) Jones in Proc. Calif. Acad. Sci. II, 5: 664. 1895.—"Dry sagebrush areas, 5500° alt., Beaver Head County, Montana, on hills west of Clark's Cañon, July, 1888."—Holotypus, collected by Frank Tweedy, *No. 9 in 1888*, US! isotypi, NY, POM (fragm.)!—*Phacopsis scaphoides* (Jones) Rydb. in Bull. Torr. Club **40**: 52. 1913. *Hesperonix scaphoides* (Jones) Rydb. in N. Amer. Fl. **24**: 439. 1929.

The Bitterroot milk-vetch, *A. scaphoides*, is a handsome plant, notable for its large, decidedly inflated but by no means bladdery, dorsiventrally compressed pods which are held erect at a distance from the raceme-axis on long, slender but rigid, incurved-ascending stipes. The epithet *scaphoides*, suggesting a pod keeled on one face and excavated like a boat on the opposite, is quite misleading, for it is precisely the doubly grooved fruit assuming the form of two parallel cylindric chambers partially fused together, separated (more or less completely) in the plane of fusion by the septum, and giving a didymous figure in cross-section, which provides the best differential character of the species as compared with the closely related *A. eremiticus*. First described by Jones as a variety of *A. arrectus*, it was maintained by him (1923, p. 163, Pl. 38) in the same category; but the "forms from Weiser" (Jones, l.c.) supposedly connecting *A. scaphoides* with the "type" of *A. arrectus* are simply (cf. *Jones*, from Weiser, Idaho, *in 1899, in 1900*, POM, NY) a minor variant of *A. eremiticus*, and irrelevant to the case. Doubtless on account of the considerably tumid fruit, Rydberg transferred the species first to *Phacopsis* and subsequently to *Hesperonix*, where it came to rest (Rydberg, 1929, p. 439) next to *A. vallaris*, a species coincidentally similar in pod-outline but greatly different in growth-habit and technical detail. According to Rydberg's generic key (1929, p. 252), *A. scaphoides* might be traced down either to *Jonesiella* or to *Hesperonix* depending on the width of the pod's septum in a given plant, a fair example of the quality of these segregate genera.

In Lemhi County, Idaho, the Bitterroot milk-vetch is known to range along the valleys of the Pahsimeroi and Salmon Rivers from Lemhi Pass near Tendoy downstream to Shoup, a distance of some fifty miles. The type-locality has not been located. There is only one exact

record from east of the Bitterroots, on lower Red Rock Creek twelve miles above Dillon, at a point about forty miles east of Lemhi Pass. The dispersal of *A. scaphoides* in Beaverhead County is obviously too little known.

XLII [redacted] (v). Subsectio Orcuttiani

Vesture basifixed, scanty; *leaflets* mostly 15–25, distant, small, obcordate; *flowers* small, rather few (6–12), loosely or remotely racemose, spreading, the banner about 10.5–12 mm. long; *petals* pink, the keel-tip sharply deltoid; *pod* spreading and evenly incurved to bring its apex to the vertical, shortly stipitate, the body linear or linear-oblanceolate in profile, triquetrously compressed, grooved dorsally, semi- or subbilocular, the valves becoming stiffly papery; *ovules* few (14–16).—Sp. 1, of subtropical desert climate, Baja California.

Astragalus sect. Reventi-arrecti subsect. Orcuttiani, stat. nov., based on *Tium* sect. *Orcuttiana* Rydb. in N. Amer. Fl. **24**: 397. 1929 & in Bull. Torr. Club **57**: 405. 1931.

165. Astragalus Orcuttianus

Slender, sparsely leafy, with a stout, woody taproot and knotty root-crown or shortly forking caudex, thinly strigulose with straight, appressed hairs up to 0.35–0.6 mm. long, the herbage green, the leaflets glabrous above; *stems* many, erect and ascending in clumps, 1.5–4 dm. long, commonly branched or spurred at several nodes preceding the first peduncle; *stipules* membranous or broadly membranous-margined, triangular or triangular-acuminate, (1) 1.5–4 mm. long, the lowest early becoming papery and fragile, the median and upper ones firmer, decurrent around ± half the stem's circumference, the blades deflexed; *leaves* (3) 5–15 cm. long, often widely divaricate, petioled but the uppermost shortly so, with slender but stiff rachis and (13) 15–21 (25) distant, broadly obovate-cuneate, suborbicular, or obcordate, retuse or emarginate, flat, sometimes clearly pinnate-veined leaflets 2–13 mm. long, diminishing upward along the rachis; *peduncles* incurved-ascending, (2) 3–12 cm. long, often shorter than the leaf; *racemes* loosely or at length remotely 6–12-flowered, the flowers spreading, the axis early elongating, 3.5–10.5 cm. long in fruit; *bracts* membranous, pallid, ovate or ovate-acuminate, 1.2–2 mm. long; *pedicels* ascending or a little arched outward distally, at anthesis slender, (1) 1.2–2.8 mm., in fruit thickened, persistent, 2.3–3 mm. long; *bracteoles* 0–2, minute when present; *calyx* 4.8–6 mm. long, thinly strigulose with black or mixed black and white hairs, the slightly oblique disc 0.8–1.3 mm. deep, the campanulate tube 2.8–3.8 mm. long, 2.7–3.1 mm. in diameter, the broadly subulate or triangular-subulate teeth 1.6–2.2 mm. long, the ventral pair commonly shortest and broadest but the dorsal one sometimes shortest, the whole becoming papery, marcescent unruptured; *petals* pink-purple; *banner* recurved through ± 45°, broadly ovate- or suborbicular-cuneate, openly and sometimes deeply notched, 9–12 mm. long, 6.2–9 mm. wide; *wings* 8.1–10.4 mm. long, the claws 2.9–3.7 mm., the obliquely oblong–elliptic to narrowly oblong-oblanceolate, obtuse or obscurely truncate-emarginate, slightly incurved blades 5.8–8.1 mm. long, 1.8–3.5 mm. wide; *keel* 7.7–8.6 mm. long, the claws 3–3.7 mm., the obliquely triangular blades 4.8–5.6 mm. long, 2.5–3.1 mm. wide, abruptly incurved through 95–105° to the sharply deltoid, porrect apex; *anthers* 0.5–0.55 mm. long; *pod* spreading and evenly incurved through ± ¼ to nearly ½-circle, the apex subvertical, the rather thick stipe 1–3 mm. long, the body linear or linear-oblanceolate in profile, (1.2) 1.5–2.2 cm. long, 3.7–3.5 mm. in diameter, cuneate at base, contracted distally into a shortly triangular, cuspidate, laterally compressed, unilocular beak, otherwise trigonously compressed, carinate ventrally by the thickened, salient, narrowly wing-margined suture, deeply but openly sulcate dorsally, the lateral faces shallowly concave, the lateral angles very obtuse, the thinly

fleshy, green, glabrous valves becoming papery, stramineous, lustrous, finely cross-reticulate, inflexed as an incomplete septum 1–1.5 mm. wide; *ovules* 12–17; *seeds* brown, minutely punctate, ± 2 mm. long.—Collections: 8 (o); representative: *Wiggins 9824* (DS); *Stombler 130* (DS); *Harbison* (from El Topo) *in 1951* (DS, RSA), *in 1953* (RSA).

Rocky slopes and washes in desert canyons, ascending to 4000 feet in Sierra San Pedro Mártir, but mostly lower, apparently not common, known from widely scattered stations on the peninsula of Baja California back from the gulf or ocean between 26° and 32° 50′ N. (San Gregorio, south Distr.; San Enrique, east slope of San Pedro Mártir range and El Topo, north Distr.).—Map No. 65.—February to June, the fruit long persisting.

ASTRAGALUS ORCUTTIANUS (Charles Russell Orcutt, 1864–1929) Wats. in Proc. Amer. Acad. **20**: 361. 1885.—"In Cantillas Cañon ("Tantillas" of Palmer), Lower California, by C. R. Orcutt, August, 1883."—Holotypus, *Orcutt 937*, collected August 2, 1883, GH! isotypus, UC!—*Tium Orcuttianum* (Wats.) Rydb. in N. Amer. Fl. **24**: 397. 1929.

Astragalus Orcuttianus var. *gregorianus* (of San Gregorio) Jones, Contrib. West. Bot. **10**: 63. 1902 *("Gregorianus")*.—"San Gregorio, Colorado Desert, California."—Holotypus, collected by T. S. Brandegee at San Gregorio, Baja California (lat. ± 26° N.), February 4, 1889, UC! isotypus (fragm.), POM!

The Orcutt milk-vetch is the only astragalus of its type known to occur in Baja California and is instantly recognized by its small, green leaflets of broad outline scattered along the stiff, often divaricate leaf-stalks, by its open racemes of few purple flowers, and finally by the linear or linear-oblanceolate, incurved-ascending pod which is contracted at base into a short stipe and dehisces in situ through its widely gaping beak. The growth-habit is curiously reminiscent of *A. porrectus*, a species very different technically in its stipules and pod-structure. The nearest relative of *A. Orcuttianus* is perhaps *A. remotus*, but it differs greatly in the coloring, shape, and proportions of the petals and in the pod's pronounced inward curvature. It is a most distinct and ornamental astragalus.

XLII [redacted] (vi). Subsectio OBSCURI

Low, slender, caulescent or subacaulescent; *vesture* basifixed; *leaflets* few, 7–15; *flowers* shortly racemose, ascending, small, the banner 7–10.5 mm. long; *petals* ochroleucous or lilac-tinged, little graduated, the keel-tip equaling the wings, triangular, beaklike; *pod* erect, sessile or nearly so, linear-oblong in profile, triquetrously compressed, grooved dorsally, subbilocular, the valves thinly leathery.—Sp. 1, of the northwestern Great Basin, northern Nevada and northern California to transmontane Oregon south of the Blue Mountains, thence east to the Snake River drainage in southwestern Idaho and just north to the upper John Day River in Oregon.

ASTRAGALUS sect. REVENTI-ARRECTI subsect. OBSCURI, subsect. nov., inter affines floribus parvulis erectis, petalis subaequilongis ochroleucis nunc sordide violascentibus, carina apice triangulari rostriformi, et legumine erecto, sessili, anguste lineari-oblongo, triquetrim compresso, subbiloculari insignes.—Sp. unica: *A. obscurus* Wats.

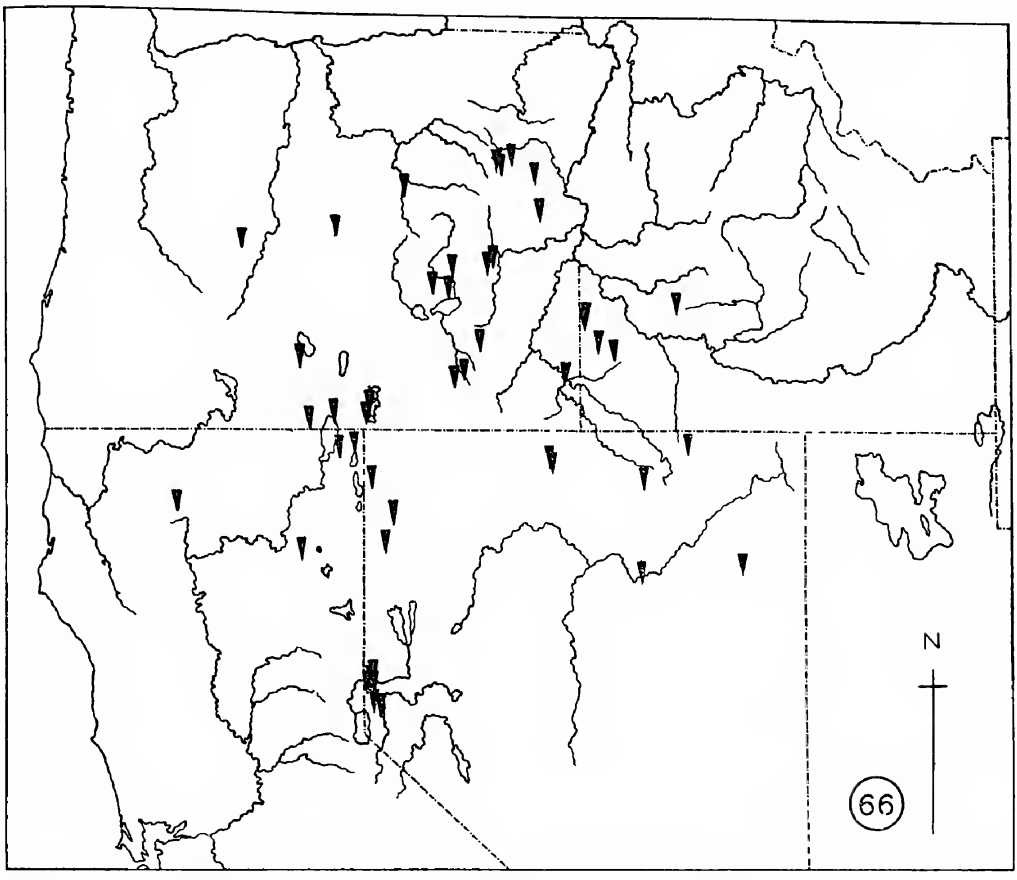
166. ASTRAGALUS OBSCURUS

Low, slender, diffusely caulescent or tufted and subacaulescent, with a woody taproot and thickened root-crown or shortly forking, suffruticulose caudex, strigulose nearly throughout with fine, straight, appressed (exceptionally ascending) hairs up to 0.3–0.55 (0.9) mm. long, the herbage greenish or subcinerous, the leaflets commonly more thinly pubescent above than beneath, exceptionally glabrous above; *stems* several or numerous, simple, 5–15 cm. long, when short the leaves and subscapose peduncles tufted on the root-crown, when developed with at least 1 and up to 5 internodes 1–5 cm. long, then radiating, prostrate or weakly ascending; *stipules* (1.5) 2–5.5 mm. long, the lowest papery, usually loosely imbricated, ovate or triangular, decurrent around ¾ to the whole stem's circumfer-

ence, free (or rarely a trifle connate at very base), the upper ones narrower, deltoid-acuminate or lanceolate, herbaceous or with herbaceous, deflexed tips; *leaves* (2.5) 4–10 cm. long, all petioled but the uppermost sometimes shortly so, with slender but rather stiff rachis and (5) 7–13 (15), remote or less often moderately spaced, flat or folded, thick-textured leaflets 2–10 (15) mm. long, varying greatly in shape and size from broadly oblong-elliptic in all or in all but the uppermost leaves to lance-oblong or linear-elliptic in all but the lowermost leaves, mostly obtuse, sometimes truncate or shallowly retuse when broad, or subacute when narrow; *peduncles* wiry, usually straight and rather rigid, sometimes incurved-ascending, 3–15 cm. long, commonly surpassing the leaf; *racemes* (3) 6–14-flowered, rather compact in early anthesis, the axis soon elongating, (1) 2–8 cm. long in fruit; *bracts* membranous or membranous-margined, ovate or lanceolate, 0.8–2.5 mm. long; *pedicels* erect or ascending at a narrow angle, straight, at anthesis 0.5–1 mm. long, in fruit somewhat thickened, 1.2–2.2 mm. long; *bracteoles* 0–2, usually 0; *calyx* (3.1) 3.6–5.5 mm. long, strigulose with black and white hairs variably proportioned, the disc 0.6–1 mm. deep, the campanulate tube (2.3) 2.8–4 mm. long, (1.7) 2–2.6 mm. in diameter, the subulate or triangular-subulate teeth 0.4–1.6 mm. long, the ventral pair often a little shorter than the rest, the whole becoming papery, marcescent, ruptured; *petals* ochroleucous or sordidly whitish, often suffused with dirty lilac; *banner* recurved through ± 45°, obovate-cuneate, deeply emarginate, 7–10.5 mm. long, (4.5) 5.5–8 mm. wide; *wings* (6.2) 6.7–9 mm. long, the claws (2.8) 3–4 mm., the lunately oblong, linear-oblong, or oblanceolate, obtuse blades (3.5) 4.3–6 mm. long, (1) 1.3–2 mm. wide; *keel* equaling or slightly surpassing the wings, (6.3) 7–10 mm. long, the claws 2.9–3.7 mm., the lunately triangular blades 3.6–5.5 mm. long, 1.6–2.6 (3) mm. wide, incurved through 80–90° to the narrowly triangular, often porrect and beaklike but ultimately obtuse apex; *anthers* (0.4) 0.45–0.6 (0.65) mm. long; *pod* erect, sessile or nearly so, the stipe if perceptible not longer than thick, the body linear-oblong in profile, straight, (1) 1.3–2.5 cm. long, 2.4–3.3 mm. in diameter, cuneate at both ends, cuspidate at apex, obtusely triquetrous with convex lateral and openly grooved dorsal faces, keeled ventrally by the prominent thick suture, the thinly fleshy, pale green, finely strigulose valves becoming leathery, stramineous, reticulate, inflexed as a nearly complete septum 1–1.4 mm. wide; *ovules* 14–23; *seeds* brown or greenish-brown, smooth or rugulose-punctate, 2.2–2.7 mm. long.—Collections: 59 (viii); representative: *Maguire & Holmgren 26,426* (NY, RSA, WS); *Cusick 2368* (ND, NY, POM); *Ripley & Barneby 6040* (CAS, RSA); *Macbride & Payson 2851* (CAS, NY); *M. & G. Ownbey 2787* (CAS, NA, NY, RSA, SMU, WS); *Holmgren 1984* (NA, NY); *Austin & Bruce 2211, 2215* (NY).

Stony flats, hillsides, and barren ridges, in sandy or stiff clay soils derived from basalt, commonly among or sheltering under low sagebrush, (2650) 3500–6500 (8000) feet, widely dispersed and locally common across northern Nevada in the drainage of the Humboldt and Carson Rivers north to the lake country of southern transmontane Oregon and northeastern California (rarely west to the foothills of the Cascades in Siskiyou County; cf. minor variant mentioned below), northeast in Oregon to the foothills of the Blue Mountain system (one station on the upper John Day River in Grant County, and two on the upper Deschutes in Crook and Deschutes Counties) and in Idaho to the southwest corner of the state in Owyhee and Elmore Counties.—Map No. 66.—May to July, the fruit long persisting.

ASTRAGALUS OBSCURUS (dark or obscure) Wats., Bot. King 69. 1871.—"... foothills near Truckee Pass, Nevada; 5500 feet altitude; May (266)."—Holotypus, US! isotypi, GH, NY!—



Map No. 66. Parts of the Great Basin, northern Nevada and adjoining states. Range of *A. obscurus.*

Tragacantha obscura (Wats.) O. Kze., Rev. Gen. 946. 1891. *Tium obscurum* (Wats.) Rydb. in N. Amer. Fl. 24: 394. 1929.

Tium miserum sensu Rydb. in N. Amer. Fl., l.c., & in Bull. Torr. Club 57: 403. 1931; non *A. miser* Dougl.

The arcane milk-vetch, *A. obscurus,* is a lowly inconspicuous astragalus of weedy aspect, demanding close scrutiny before it reveals its particularity of structure, but then easily recognized. The few leaflets, the small, dingy flowers ascending in a rather close raceme, the scarcely graduated petals with beaklike keel-tip, and the erect, sessile, linear-oblong, trigonously compressed pod form a combination unique in sect. *Reventi-arrecti.* Jones (1923, p. 181) thought the species related (or "in some forms very close") to *A. atratus,* but this differs greatly in the form of the flower and in the pendulous pod. It is true that *A. obscurus* and *A. atratus* are sympatric and often directly associated in northern Nevada, but this of itself is less suggestive of relationship (in fact, the opposite) than of similar ecological adaptation.

Variation in outline and amplitude of the leaflets is a feature of *A. obscurus,* noted in detail by Jepson (1936, p. 372); it was Rydberg's excuse for maintaining two species, *Tium obscurum* and *T. miserum.* The latter (wrongly identified with *A. miser* Dougl., q.v.) corresponds with the more pronouncedly xerophytic state in which narrow leaflets are supposedly, but not, in fact, correlated with short, tufted, subacaulescent stems. The relatively uncommon phase with broad leaflets is, however, nearly always strongly caulescent, tends to have a slightly larger flower, and occurs in more protected sites, often in shelter of sagebrush. The number of black calyx-hairs, emphasized as an additional distinguishing character (Rydberg, 1929, p. 385), has no bearing on the case.

The vesture of the arcane milk-vetch is usually strictly appressed and composed of short, straight hairs up to 0.3–0.55, rarely 0.7 mm. long. A remarkable plant from the northern foothills of Mount Shasta in Siskiyou County (north of Weed, *J. T. Howell 1786*), pubescent with

extremely fine, loosely ascending hairs up to 0.7–0.9 mm. long, is interpreted for the present as a minor variant, but may prove, as more material becomes available, to represent a distinct variety. The station marks the westernmost outpost of *A. obscurus* in California and lies nearly one hundred miles distant from the nearest in Modoc County.

XLIII. Sectio MICHAUXIANI

Tall, caulescent perennials, with shortly buried root-crown and few or solitary stems; *stipules* free; *leaves* imparipinnate, with mostly 21–35 leaflets; *flowers* loosely racemose, horizontal or somewhat declined at full anthesis, of moderate size, the banner ± 14–19 mm. long; *pedicels* thickened in fruit, persistent; *calyx-tube* campanulate, the sinuses between the teeth silky-ciliate; *petals* whitish or pink-purple, regularly graduated, the keel-tip sharply deltoid-triangular; *pod* incurved-ascending, subsessile, persistent, narrowly oblong-ellipsoid, dorsiventrally compressed, keeled ventrally, grooved dorsally, semibilocular, the valves stiffly leathery or subligneous; *ovules* 30–40.—Sp. 1, xerophyte, of the Atlantic Coastal Plain, North Carolina to central Florida.

Astragalus sect. Michauxiani, sect. nov., ab auctoribus cum *A. distorto* vel *A. arrecto* hucusque consociati, ab illo legumine marcido erecto subbiloculari totoque habitu diversi, ab *Arrectis* sectionis praecedentis praesertim radicis collo subterraneo, caulibus subsolitariis, itaque habitu suo separandi.—Sp. unica: *A. Michauxii* (O. Kze.) F. J. Hermann.

The Michaux milk-vetch is greatly isolated geographically from any member of the genus morphologically similar, and although it is natural to associate it with sect. *Reventi-arrecti* on technical grounds, the real affinity seems to me wholly doubtful. The solitary or paired (exceptionally up to 5) stems arising from the buried crown of an often oblique taproot and the curious silky fringe of hairs bordering the sinuses between the calyx-teeth are notable features of the species.

167. Astragalus Michauxii

Tall but slender, with a simple or forked, obliquely descending, woody root terminating a few cm. below ground in an at length somewhat swollen, knotty crown, the virgate stems glabrous or nearly so, the herbage usually very thinly strigose-pilosulous with fine, loosely ascending or subappressed, straight or partly wavy hairs up to 0.5–0.9 (1) mm. long, sometimes almost glabrous up to the inflorescence, the leaflets green, bicolored, thinly pubescent on both faces, on the lower only, or merely ciliate; *stems* usually solitary, sometimes 2 (5), erect or flexously ascending, simple or sometimes branched near the base, striate, leafless proximally, (3.5) 4.5–9 dm. long, composed of some 9–14 developed internodes, floriferous from the uppermost 2–6 leaf-axils; *stipules* 0.5–2.5 mm. long, those at the lowest, leafless nodes papery-membranous and mostly broader than long, forming a low, semiamplexicaul collar, the median and upper ones herbaceous, membranous-margined, ciliate or beset with a few marginal processes, embracing less than half the stem, the deltoid or triangular blades abruptly deflexed; *leaves* sessile or subsessile, the lowest rarely shortly petioled, (4.5) 7–17 cm. long, with (15) 21–33 (35) narrowly oblong, lance-elliptic, narrowly oval, or (in some reduced upper leaves) sublinear, commonly retuse but sometimes obtuse, flat, conspicuously petiolulate leaflets (3) 6–26 mm. long, the midrib prominent beneath; *peduncles* stiffly erect or incurved-ascending, 6–15 cm. long, usually a little shorter, sometimes a trifle longer than the leaf; *racemes* loosely (12) 15–40-flowered, the axis elongating, 5–15 (18) cm. long in fruit; *bracts* membranous-margined, ovate or lanceolate, 1–3 mm. long; *pedicels* densely silvery-pilosulous (more densely so than the calyx), at early anthesis straight and ascending, 0.6–2 mm. long, in fruit arched outward, clavately thickened, 2–3 mm. long; *bracteoles* 0; *calyx* (5.7)

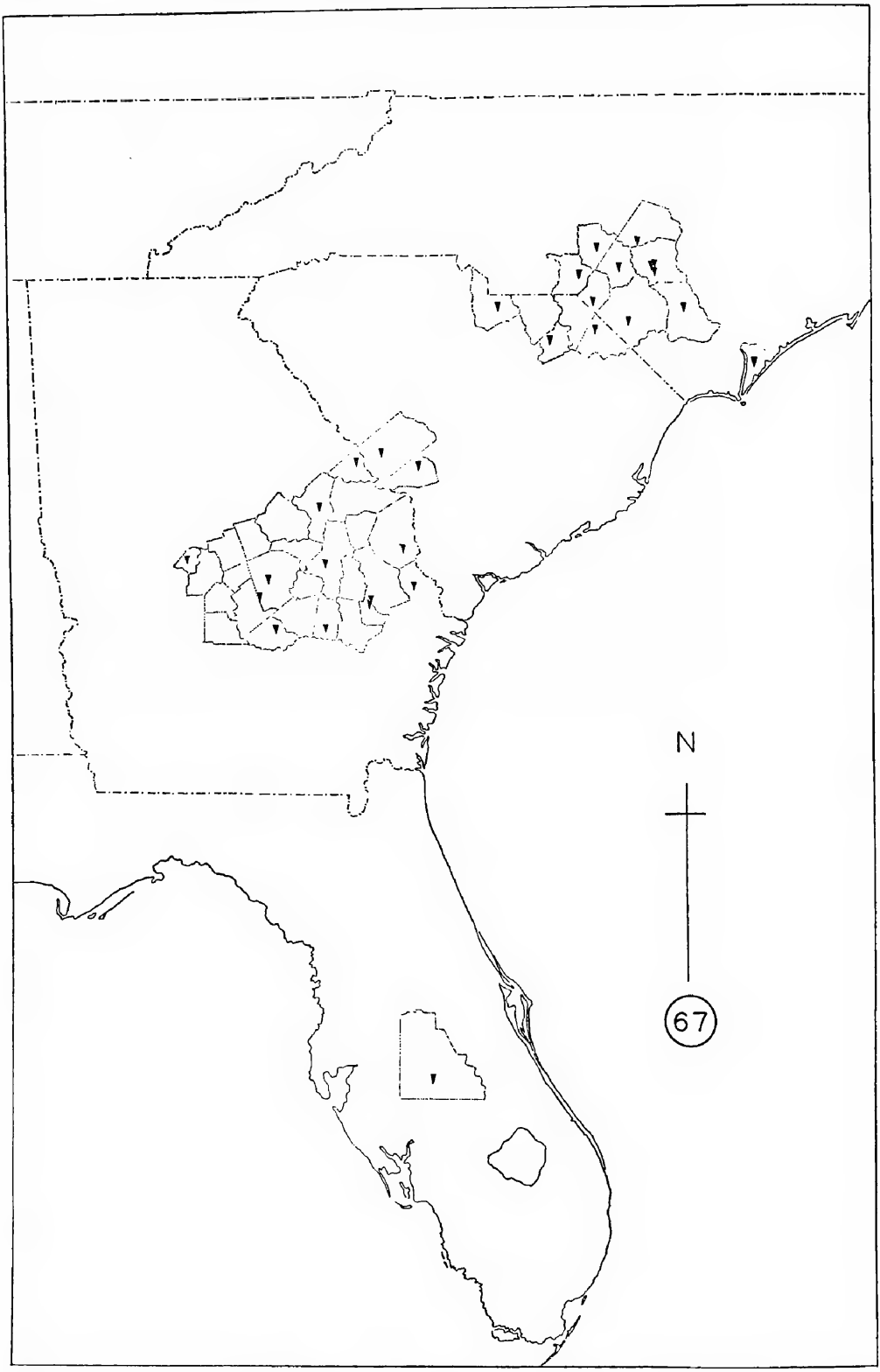
6–8.3 mm. long, the tube thinly white-strigulose but the inner surface and margins of the teeth and the sinuses between them densely silvery-pubescent, the subsymmetric disc 1–1.5 mm. deep, the campanulate, often purplish tube (4.7) 5–6.3 mm. long, 3.4–4.3 mm. in diameter, the broadly subulate, triangular, or deltoid teeth 1–2.3 long, the ventral pair broadest and often shortest, the whole becoming papery-scarious, ruptured, persistent; *petals* pale purple, lilac, or whitish faintly lilac-tinged and -veined; *banner* recurved through ± 40°, ovate-cuneate or broadly rhombic-elliptic, deeply notched, (13.5) 14.4–18.8 mm. long, (7.2) 8–10.5 mm. wide; *wings* equaling or a little shorter than the banner, 13.1–18.8 mm. long, the claws (5.4) 5.8–7.5 mm., the elliptic-oblanceolate, obtuse or obscurely emarginate, gently incurved blades 8.4–11.4 mm. long, 3–4 mm. wide; *keel* 12.5–15 mm. long, the claws 5.8–7.3 mm., the lunately elongate-triangular blades 7.3–9.9 mm. long, 3.1–3.6 mm. wide, incurved distally through 80–95 (rarely 60)° to the sharply deltoid-triangular apex; *anthers* 0.65–0.9 mm. long; *pod* incurved-ascending or suberect, subsessile, narrowly oblong-ellipsoid, incurved through ⅛–¼-circle, 2.3–3.1 cm. long, 4.5–6 mm. in diameter, cuneately tapering at the base into an obscure, thick, stipelike neck up to 1 mm. long, abruptly contracted distally into a short, triangular, laterally compressed, rigidly cuspidate beak, otherwise dorsiventrally compressed, the flat or low-convex ventral face carinate by the thick, prominent suture, the dorsal face shallowly and openly sulcate, the green, fleshy, glabrous valves becoming stiffly leathery or subligneous, brownish-stramineous, prominently cross-reticulate, inflexed as a narrow, incomplete septum about 0.8–1 mm. wide; *dehiscence* imperfectly known, apparently apical; *seeds* (seldom seen) brown, smooth, somewhat lustrous, 1.8–2 mm. long.—Collections: 22 (iii); representative: *Godfrey 49,208* (SMU, WS); *Ripley & Barneby 7332* (GH, RSA), *7336* (NY, RSA); *Cronquist 5026* (NY, SMU, WS); *McVaugh 8637* (SMU, TEX).

Dry sandy scrub-oak and pine woods of the Atlantic Coastal Plain, sometimes on white sandhills, apparently uncommon and usually found in small, scattered colonies, mostly below 500 feet, southeastern North Carolina; southeastern Georgia, and adjoining South Carolina; central Florida.—Map No. 67.—Late March to June.

ASTRAGALUS MICHAUXII (O. Kze.) F. J. Hermann in Jour. Wash. Acad. Sci. 38: 237. 1948, based on *Tragacantha Michauxii* (André Michaux, 1746–1802) O. Kze., Rev. Gen. 941. 1891, based in turn on *Astragalus glaber* (hairless) Michx., Fl. Bor.-Amer. 2: 66. 1803 (non Lamk., 1783).—"Hab. in sabulosis aridis Georgiae."—Holotypus, P! isotypus (a pod only), labeled "*Astragalus glaber,* herb. Michx.," NY! phototypus (ex herb. Michx., P), GH!—*A. apilosus* (hairless) Sheld. in Minn. Bot. Stud. 1: 22. 1894, a later substitute for *A. glaber* Michx. non Lamk. *Tium apilosum* (Sheld.) Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903. *T. Michauxii* (O. Kze.) Rydb. in N. Amer. Fl. 24: 392. 1929.

The Michaux milk-vetch, the only tall, erect astragalus in its area of dispersal, is easily recognized by its elongate, usually solitary and always few stems floriferous from the last two to six leaf-axils, by the numerous, subglabrous leaflets, and by the erect or incurved-ascending, semibilocular, glabrous pod of narrowly oblong-ellipsoid outline and fleshy, finally subligneous texture. The concentration of hairs on the calyx into a narrow band around and within the teeth and the sinuses between them is a striking feature of *A. Michauxii* duplicated only in the southern Californian *A. Douglasii* var. *Parishii* and a few related forms. The fresh flower, as I have seen it in North Carolina and Georgia, is pale lilac-purple, but the pigment fades rapidly in dried specimens. As a general rule the Georgia populations have slightly larger flowers and are more nearly truly glabrous below the inflorescence than those from North Carolina of which I have seen samples; but the size-differences are not large and seem taxonomically insignificant.

On a sheet of *A. Michauxii* from Telfair County, Georgia (NY, without further data) there is a note in Dr. Britton's hand to the effect that "This is *Psoralea multijuga* Ell., as determined from a specimen in Herb. Elliott." The typus of *P. multijuga* Ell. (Bot. S. C. & Ga. 2: 198. 1822—"Collected . . . in Abbeville District by Mr. Gourdine, and sent to me by Dr. Mac-



Map No. 67. South Atlantic United States. Range of *A. Michauxii* (some stations by courtesy of H. E. Ahles).

bride") was re-examined subsequently by Weatherby, who reported (in Rhodora 44: 259. 1942) that the plant resembles *A. Michauxii* in habit and foliage, but that the inflorescence appears quite different. Weatherby came to no conclusion as to the identity of *P. multijuga,* but I feel that Elliott's description of its "trailing stem" and especially its "monospermous germ" are impossible to reconcile with the erect growth-habit and 30–40 ovules of the astragalus. The existence of an *A. multijugus* DC. (1825) fortunately ensures that Elliott's proposal can have no effect on the nomenclature of the present species. It may be worth noting that there is an old specimen of *A. Michauxii* in the Muhlenberg herbarium (PH) acquired (cf. Muhlenberg's manuscript "Observationes") from Stephen Elliott, who must therefore have had first-hand experience of the Michaux milk-vetch.

The Sherard herbarium (OXF) possesses a specimen of *A. Michauxii* collected by Catesby in 1724. It is accompanied by a diagnostic phrase: *Astragalus Carolinianus foliis angustioribus glabris, floribus pallide luteis in spicis longissimis laxius dispositis.* In certain respects, especially the determinate *("non repens")* root, leaflets up to 31–33, and origin in Carolina, the plant suggests Dillenius' *Astragalus procerior non repens flore e viridi flavescenti* (Hort. Eltham. 45. 1732), the basis of *A. carolinianus* L. It is curious that *A. procerior* etc. is apparently lacking from the Dillenian herbarium. However the plate (Tab. XXXIX) of *A. procerior etc.* unquestionably portrays some form of *A. canadensis,* and an identification of *A. Michauxii* with *A. carolinianus* would not be justified.

XLIV. Sectio NUDI

Sparsely leafy, caulescent perennials with superficial or shallowly buried root-crown; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, the leaflets few (mostly 5–11), often greatly reduced in size or number in the upper leaves and the terminal one sometimes confluent with the rachis; *flowers* loosely racemose, ascending, rather large, the banner 14.5–26 mm. long; *pedicels* clavate-thickened, persistent; *calyx* cylindric or cylindro-campanulate, circumscissile; *petals* purple (with paler wing-tips) or ochroleucous purple-tinged, regularly graduated, the keel obtuse; *pod* erect, sessile, persistent, ovoid or oblong-ovoid, subterete, the fleshy, glabrous valves becoming woody, inflexed as a narrow, sometimes subobsolete septum; *dehiscence* apical, through the gaping beak; *ovules* 29–42.—Sp. 1, xerophyte, of western Nevada and the White and Inyo Mountains of adjoining California.

ASTRAGALUS sect. NUDI, comb. nov., based on *Brachyphragma* sect. *Nuda* Rydb. in N. Amer. Fl. 24: 399, in clave. 1929.—Sp. typica: *B. Serenoi* (O. Kze.) Rydb. = *A. Serenoi* (O. Kze.) Sheld.—*Brachyphragma* Rydb., l.c. 1929.—Generitypus: *B. Serenoi* (O. Kze.) Rydb.

The naked milk-vetch, *A. Serenoi,* so named because the calyx becomes scarious and fragile as the ovary matures and finally falls away by circumscissile fission leaving the ripening fruit naked, was placed by Jones (1923, p. 150) in his unreasonably inclusive sect. *Podosclerocarpi,* a mixture of emmenoloboid and piptoloboid species dispersed in these pages among the *Pectinati, Pterocarpi,* and other small groups. It was keyed out by Jones in a subsect. *Pachypodes,* the typus of which, *A. pachypus,* although perhaps distantly related, is distinct enough in its broadly campanulate calyx-tube and stipitate, laterally flattened, fully bilocular legume to deserve a section of its own. The unique character of *A. Serenoi* was recognized by Rydberg who based the genus *Brachyphragma* (and the sect. *Nuda*) upon it. The technical characters of *A. Serenoi* all point to an affinity with sect. *Reventi-arrecti,* many members of which have erect, persistent, semibilocular pods of fleshy, finally subligneous texture; but it differs from these in its sparsely leafy, rushlike growth and few leaflets commonly much reduced in size and number in the upper leaves, so that the general appearance of the plants is peculiar and idiosyncratic.

168. ASTRAGALUS SERENOI

Commonly robust, with a woody, pluricipital taproot, strigulose with appressed, flattened, straight hairs up to 0.3–0.5 mm. long, the stems thinly so, the herbage greenish or cinereous, the leaflets more densely pubescent above than beneath, commonly silvery-canescent; *stems* several or numerous, erect and ascend-

ing in bushy clumps, 1.5–4.5 dm. long, simple and leafless at base, paniculately 1–several-branched from the lower and median leafy nodes (exceptionally simple), zigzag distally; *stipules* 1.5–5 mm. long, the lowest papery-scarious, mostly ovate and obtuse, semi- or almostly fully amplexicaul-decurrent, the median and upper ones progressively smaller, deltoid or triangular-acuminate, with subherbaceous, spreading or commonly deflexed blades; *leaves* 2–15 cm. long, shortly petioled, with stiff, often divaricate, or deflexed and distally incurved rachis and (1) 5–11 distant, linear, linear-oblanceolate, or filiform, rarely lanceolate, acute or subacute and often mucronate, flat or folded leaflets 5–30 mm. long, those of the uppermost leaves usually much reduced in size or lacking, and the terminal one obscurely differentiated from or confluent with the rachis; *peduncles* stout, erect, 3–25 cm. long; *racemes* loosely, at length distantly (3) 5–25-flowered, the flowers ascending, the axis becoming 2–20 cm. long in fruit; *bracts* submembranous, ovate or lance-acuminate, 1.5–4.5 mm. long; *pedicels* narrowly ascending, straight, at anthesis slender, 0.7–2 (2.4) mm. long, in fruit thickened, 2–4 mm. long; *bracteoles* nearly alway 2; *calyx* 7.9–13.7 mm. long, strigulose with black or largely black hairs, the turbinate or turbinate-campanulate, slightly oblique disc 1.4–2.5 mm. deep, the tube varying from cylindro-campanulate to narrowly cylindric, the lance-subulate teeth 1.5–4.3 mm. long, the ventral pair usually broadest and shortest, the orifice oblique, the whole becoming scarious, fragile, irregularly circumscissile; *petals* of various colors (cf. infra); *banner* gently recurved through 35–45°, ob-lanceolate, rhombic, or rhombic-oblanceolate, shallowly notched, 14.5–26 mm. long, 6.4–12 mm. wide; *wings* shorter, with narrowly oblong or oblong-oblanceo-late, obtuse or suberose, straight or slightly incurved blades; *keel* again shorter, 12.8–18.5 mm. long, the lunately half-elliptic blades gently incurved through 70–85 (90)° to the rounded apex; *anthers* 0.6–0.75 mm. long; *pod* erect, sessile, obliquely ovate or plumply oblong in outline, 1.5–3 cm. long, 5–9 (10.5) mm. in diameter, obtuse or truncate at base, abruptly cuspidate at apex, straight or a little incurved, when first formed subterete but becoming a trifle compressed either laterally or dorsiventrally in ripening, the green, fleshy, glabrous, lustrous valves shrinking to expose the prominent, cordlike sutures, finally becoming stramineous, woody, transversely rugulose-reticulate and wrinkled lengthwise, inflexed as a narrow, partial or sometimes subobsolete septum up to 2.5 (3.2) mm. wide; *dehiscence* primarily apical, through the gaping beak and half-way down through the ventral suture, also tardily splitting to the base through the dorsal suture and the exocarp exfoliating from the endocarp to expose the separated outer walls of the septum; *ovules* 29–42; *seeds* olivaceous or orange-brown, sometimes purple-speckled, sparsely pitted but somewhat lustrous, 2.4–3.3 mm. long.

Key to the Varieties of A. Serenoi

1. Peduncles and raceme-axes together 1.5–4 dm. long, the pods and usually the flowers far exserted from beyond the leaves; *calyx-tube* 3–4 mm. in diameter; *petals* lilac or purple with white or pallid wing-tips, strongly graduated, the banner 4.5–8.5 mm. longer than the keel; *pod* oblong, broadest at the middle, semibilocular, the septum ± 2–3 mm. wide; range of the species ..... 168a. var. *Serenoi*

1. Peduncles and raceme-axes 0.6–1.5 dm. long, the flowers and pods exserted only just beyond the leaves; *calyx-tube* narrowly cylindric, 2.4–2.8 mm. in diameter; *petals* sordidly ochroleucous, the keel- and wing-tips purplish, the banner only 1.5–2.5 mm. longer than the keel; *pod* obliquely ovoid, broadest below the middle, sub-unilocular, the septum 0.5 mm. wide or less; local in Nye County, Nevada ..... 168b. var. *sordescens*

168a. Astragalus Serenoi var. Serenoi

Stems 2–4.5 dm. long; *leaves* 5–15 cm. long; *peduncles* (7) 10–25 cm. long; *racemes* (3) 7–25-flowered, the axis (2) 5–20 cm. long; *banner* 17–26 mm. long,

7.4–12 mm. wide; *wings* 14.7–19.8 mm., the claws 6.6–10 mm., the blades 8.2–11 mm. long, 2.3–3.1 mm. wide; *keel* 12.4–18.5 mm. long, the claws 6.4–11.5 mm., the blades 5.9–7.5 mm. long, 2.8–3.4 mm. wide; *pod* plumply oblong in outline, 1.7–3.1 cm. long, 7–10.5 (12) mm. in diameter, straight or slightly incurved but the salient sutures nearly parallel, abruptly contracted at apex into a stout, pungent cusp; *seeds* 2.8–3.3 mm. long.—Collections: 19 (ii); representative: *A. Heller 8269* (CAS, G, ND, NY); *Duran 544* (CAS, DAV, NY, OB, WIS); *Maguire & Holmgren 25,265, 25,395* (NY, RSA, WS); *Archer 6875* (NA, NY).

Open places on dry hillsides and on canyon benches, in gravelly, alkaline clay soils, associated with sagebrush and piñon-juniper forest (4700) 5000–7400 feet, local but forming colonies, western Nevada, from the West Humboldt Mountains, Pershing County, south to the Palmetto Range and White Mountains in Esmeralda County and the Inyo and Cottonwood Mountains in Inyo County, California.—Map. No. 68.—May to July, the fruit often persisting over winter on stiff, dead stems.

ASTRAGALUS SERENOI (O. Kze.) Sheld. in Minn. Bot. Stud. 1: 130. 1894, based on *Tragacantha Serenoi* (Sereno Watson, 1826–1892, botanist on King's Exploration of the 40th Parallel, 1869–70) O. Kze., Rev. Gen. 941. 1891, a substitute for *A. nudus* (naked, of the pod) Wats., Bot. King 74. 1871 (non *A. nudus* Clos, 1846).—"West Humboldt Mountains, Nevada; 5000 feet altitude; May, June. 280."—Holotypus, collected in 1868, US! isotypi, GH, NY!—*A. oblatus* (flattened at the poles, of the pod) Sheld. in op. cit. 21. 1894, an independent substitute for *A. nudus* Wats. non Clos. *A. Watsonianus* (Sereno Watson) Spegazz. in Anal. Mus. Nac. Buenos Aires 7: 265. 1902 (non *A. Watsonianus* Sheld., 1894), a further substitute for the same. *Brachyphragma Serenoi* (O. Kze.) Rydb. in Amer. Jour. Bot. 16: 205, Pl. XVII, fig. S. 1929.

Astragalus Shockleyi (William Hillman Shockley, 1855–1925) Jones in Proc. Calif. Acad. Sci. II, 5: 659. 1895.—"Fish Lake Valley, Nevada. Shockley, July 20, 1886."—Holotypus, *Shockley 527,* CAS! isotypi, NA, ND! *Brachyphragma Shockleyi* (Jones) Rydb. in N. Amer. Fl. 24: 400. 1929.

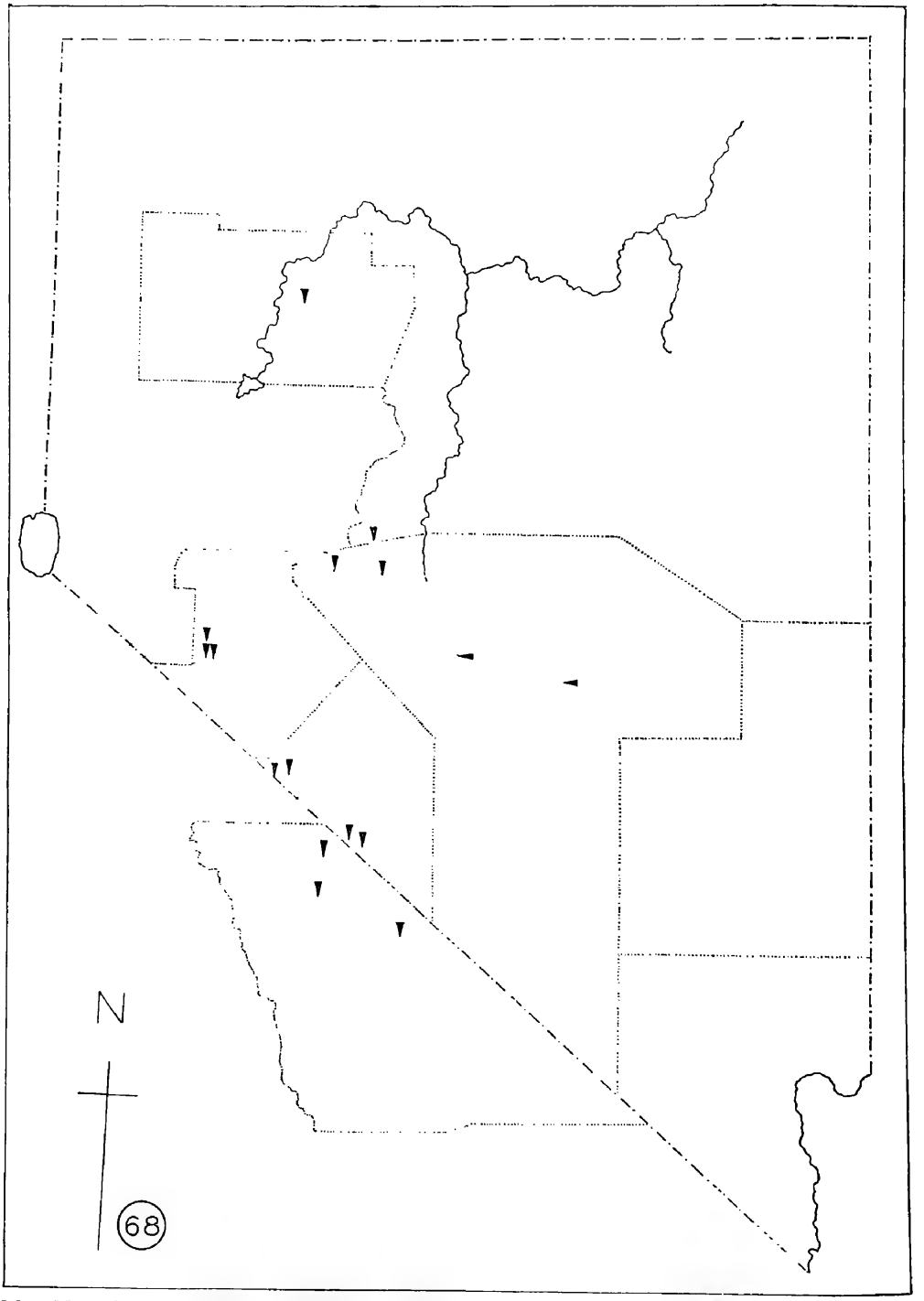
Astragalus canonis (of a canyon) Jones, Contrib. West. Bot. 8: 15. 1898.—"Big Indian Canyon near Hawthorne, Nev., May 27, 1897..."—Holotypus, POM! isotypi, MO, NY, POM (3 sheets), US (2 sheets)!

The naked milk-vetch, var. *Serenoi,* a tall astragalus readily recognized by its wiry, bushy-branching habit of growth, few, narrow, distantly disposed leaflets usually silvery above and greenish beneath, and loose racemes of rather long but narrow, purple flowers giving rise to plumply or narrowly oblong, subterete fruits of fleshy, ultimately ligneous texture, is conspicuously variable only in the length and amplitude of the pod. The plants described by Jones as *A. Shockleyi* and *A. canonis* represent the extremes of variation, the former having a relatively short and narrow, the latter an exceptionally large and broad pod; but neither can be detached from the uninterrupted series of intermediate states of which Watson's original *A. nudus* forms a part. The populations of var. *Serenoi* found near the east base of the Wassuk Range above Walker Lake, from which the typus of *A. canonis* was taken, are unusually vigorous and some have relatively broad, linear-lanceolate rather than truly linear leaflets. In his summary account of the genus Jones (1923, p. 150) reduced *A. Shockleyi* to the synonymy of *A. Serenoi* and suggested that *A. canonis* was probably no more than a form of the same, an opinion borne out by subsequent exploration of western Nevada. The differential characters attributed by Rydberg (1929, p. 399, in clave) to *Brachyphragma Shockleyi* have proved of no practical use. The variation in the fruit is well illustrated by Jones's figures on Plates 32 and 74 of his Revision.

168b. ASTRAGALUS SERENOI var. SORDESCENS

More slender than var. *Serenoi,* the stems 1.5–3 dm. long; *leaves* 2–10 cm. long; *peduncles* 3–10 cm. long; *racemes* 5–15-flowered, the axis 2–7 (10) cm. long in fruit; *calyx* 7.9–10.2 mm. long, the teeth 1.5–2.5 mm. long; *flowers* shorter and with narower petals, the banner 14.5–16 mm. long, 6.4–8 mm. wide; *wings* 13.5–14.8 mm. long, the claws 7.2–7.8 mm., the blades 7–7.7 mm. long, 1.9–2.2 mm. wide; *keel* 12.7–14 mm. long, the claws 7.2–8.4 mm., the blades 6–6.4 mm.

long, 2.5–2.7 mm. wide; *pod* 1.5–2.2 cm. long, 5–7 mm. in diameter, somewhat incurved, subunilocular, the septum not over 0.5 mm. wide; *seeds* ochraceous, minutely purple-speckled, lustrous but sparsely pitted, 2.4–3 mm. long—Collections: 3 (ii); representative: *Kent McKnight 42* (BRY).



Map No. 68. Nevada and adjoining California. Range of *A. Serenoi*: ▼ var. *Serenoi*; and ♦ var. *sordescens*.

Gentle slopes and flats, among and often sheltering under or scrambling up through low sagebrush, 5000–6800 feet, known only from northcentral Nye County (south of Belmont; 35 miles northeast of Warm Springs), Nevada.—Map No. 68.—May to July.

ASTRAGALUS SERENOI var. SORDESCENS (dirtyish, of the flower-color) Barneby in Leafl. West. Bot. 7: 195. 1954.—"NEVADA: foothills of the Toquima Range, 7 miles s. of Belmont, Nye Co. . . . *Ripley & Barneby 3673,* flor., *4000,* fruct . . . "—Cotypi, collected May 30, July 19, 1941, CAS! isotypi, NA, NY, RSA!—*A. Shockleyi* sensu Barneby in Leafl. West. Bot. 3: 113. 1942; non Jones.

The flower of var. *sordescens* is smaller and narrower than that of the typical naked milk-vetch, and tawny yellow except for the sordidly purplish wing- and keel-tips and the purplish veining of the banner. I first ascribed it (l.c.) to *A. Shockleyi,* known at the time only from fruiting material, and the true differential characters were not appreciated until much later. I may have been influenced in my misidentification by the proximity to var. *sordescens* of a Fish Lake Valley suggestive of the type-station of *A. Shockleyi,* although I have since learned from the label of a topotypus (*Shockley 527,* NA, NY) that this was actually in Esmeralda County. The comparatively short, shortly pedunculate racemes and small, obliquely ovoid, subunilocular fruit provide further means, for the present, of distinguishing var. *sordescens;* although one may question whether the differential characters will be found consistently correlated as more populations are studied.

XLV. Sectio CONJUNCTI

Shortly caulescent or subacaulescent perennials, with superficial root-crown or knotty caudex, the stems mostly shorter than the first, elongate and often subradical peduncle, or at least shorter than the first peduncle and raceme together; *vesture* basifixed; *stipules* scarious or early becoming so, all or at least the lowest connate (the sheath sometimes ruptured in age); *leaves* imparipinnate, with 13–37 leaflets, the terminal one rarely decurrent; *flowers* loosely racemose, ascending or nodding at full anthesis, variable in size, the banner 11.5–25.5 mm. long; *petals* whitish, ochroleucous, or purple, regularly graduated (the wings rarely longest), the banner recurved through 45–90°, the keel-tip obtuse; *pod* erect, sessile or stipitate, persistent with the thickened pedicel until after dehiscence, oblong-ellipsoid or ovoid-acuminate, ± obcompressed, with thick, salient sutures and fleshy, at length stiffly leathery or woody valves, these not or only very narrowly inflexed; *dehiscence* apical, through the gaping beak; *ovules* 16–35.—Spp. 4, xerophytes, of the Columbia Basin and northern Great Basin, interior Oregon and Washington and southwestern Idaho.

ASTRAGALUS sect. CONJUNCTI, sect. nov., *Reventis-arrectis* arcte affines praesertim stipulis inter se concretis dissimiles.

Both individually and collectively the *Conjuncti* resemble some *Reventi-arrecti,* and a truly remarkable parallelism in modification of the pod can be traced from species to species in the two groups. The resemblances are so great, indeed, that Jones subordinated two of the present *Conjuncti* to a comparable member of *Reventi-arrecti,* and he submerged a third completely in its counterpart in the other section. Until it can be shown that the stipular character is unstable, an unlikely prospect considering the large amount of material which has withstood the test of close scrutiny, it is preferable to treat the *Conjuncti* as a group apart.

With the present section I begin to take up a series of sections all of which seem related to the *Reventi-arrecti* but differ primarily in their connate stipules. Whether this feature is a primitive survival or a recent acquisition is a question to which a firm answer lies, unfortunately, beyond the horizon of certain knowledge. The numerous similarities in general organization and finer detail between the *Conjuncti* and *Reventi-arrecti,* mentioned at greater length under each species, can be explained reasonably only by assuming the existence of common precursors at no great distance in time past; and the close interrelationships manifestly existing between pairs of the *Conjuncti* themselves bespeak a comparatively recent origin. The species are native primarily to the basalt formations which cover so large a part of the

Columbia Basin and may have differentiated out since the elevation of the Cascades. The four sections next in order, *Hesperonix, Bicristati, Porrecti,* and *Ampullarii,* groups of one or two species apiece, are more specialized morphologically and their members are, furthermore, either very rare, localized in distribution, or both. Whether these represent sudden, recent modifications due to mutations of relatively immense scope or, as seems probable, the end-products of old evolutionary lines, is a problem for the future.

The following account of sect. *Conjuncti* follows a revision already published (Barneby, 1956, pp. 491–493). Some aspects of their history were more fully elaborated at that time.

Key to the Species of Sect. Conjuncti

1. Calyx-tube cylindric or subcylindric, the tube ± twice as long as its diameter; *ovary* glabrous; *ovules* 23–30; transmontane Oregon, mostly above 2000 ft. where its range approaches those of the following, from Wasco to Baker County, s.-e. into s.-w. Idaho ..... 169. *A. conjunctus*
1. Calyx-tube campanulate, ± 1½ times as long as its diameter; *ovary* either glabrous or pubescent; Washington and extreme n. Oregon, but in Oregon only along and near the Columbia River much below 2000 ft. (2)
   2. Ovary and sessile pod pubescent; *calyx* over 11 mm. long; *ovules* 16–22; within and near the Columbia Gap, Wasco and Hood River Counties, Oregon, and Klickitat County, Washington ..... 170. *A. hoodianus*
   2. Ovary glabrous, or if pubescent then the pod stipitate and the calyx less than 1 cm. long; *ovules* 22–32; Washington, in Klickitat County, n.-ward, and Sherman County, Oregon (3)
      3. Pod (glabrous) sessile; *calyx-tube* nearly always over 5 mm. long; Klickitat, Yakima, and Kittitas Counties, crossing to the s. bank of the Columbia in Sherman County, Oregon ..... 171. *A. reventiformis*
      3. Pod (either glabrous or strigulose) stipitate, the stipe at least 3 mm. long; *calyx-tube* 3.2–4.9 (5.8) mm. long; Kittitas, Chelan, and Douglas Counties, Washington ..... 172. *A. Leibergi*

169. Astragalus conjunctus

Subacaulescent or shortly caulescent, with a stout, woody, pluricipital taproot and shortly forking, cespitose caudex, thinly strigulose with fine, appressed and subappressed, mostly straight hairs up to 0.35–0.55 mm. long, the herbage greenish or subcinereous in youth, the base of the stems often, and the upper leaflet-surface nearly always glabrous; *stems* several or numerous, robust or quite slender, erect and stiffly ascending in clumps, 1–10 (14) cm. long, simple above the immediate base, composed of (1) 2–5 developed internodes (up to 6 cm. long, mostly shorter), the whole axis shorter than the inflorescences; *stipules* scarious, 3–10 (11) mm. long, the lowest connate into a bidentate sheath, this often ruptured in age by the developing stem, the median and upper ones narrower, very shortly connate or cauline, with lanceolate or deltoid-acuminate blades beset with a few minute peg- or tack-shaped processes; *leaves* erect, mostly clustered in a subradical tuft, (6) 10–30 cm. long, with stiffly wiry petiole and rachis and (9) 13–25 (31) distant and often scattered, linear-oblong, -elliptic, lanceolate, or subfiliform, obtuse, acute, rarely retuse, flat or involute leaflets 3–23 mm. long, the terminal one sometimes continuous with the rachis, the lateral ones readily disjointing in age; *peduncles* commonly stout, stiffly erect or divergent in fruit, 1–3.3 dm. long, a little shorter to much longer than the leaves; *racemes* loosely 7–17 (20)-flowered, the flowers at full anthesis ascending or loosely spreading (but not nodding), the axis elongating, (3) 4–12 (15) cm. long in fruit; *bracts* membranous, narrowly ovate to linear- or lance-acuminate, 2–4.5 mm. long; *pedicels* at anthesis slender, 1–2 mm. long, in fruit erect or narrowly ascending, clavately thickened, 2–4.5 mm. long; *bracteoles* nearly always 2; *calyx* (7) 8.5–12 mm. long, strigulose-pilosulous with black or largely black hairs up to 0.45–0.9 mm. long, the oblique disc 1–1.5 mm. deep, the membranous, cylindric or subcylindric tube (5.7) 6–9.2 mm. long, 2.5–4 mm. in diameter, the subulate teeth 1.3–3 (4) mm. long, the ventral pair

commonly broadest and directed away from the broad ventral sinus, the whole becoming scarious, fragile, irregularly circumscissile; *petals* whitish with purple keel-tip, or with banner and wing-tips also suffused with lilac-blue or purple; *banner* recurved through 45°, oblanceolate or broadly rhombic-oblanceolate, emarginate, 16–25.5 mm. long, 6.7–10.5 mm. wide; *wings* 14.2–22.3 mm. long, the claws 7–11.5 mm., the oblong-oblanceolate, obtuse or obscurely emarginate, straight or slightly incurved blades 8.3–13 mm. long, (1.8) 2.5–4 mm. wide; *keel* 11.6–17.5 mm. long, the claws 6.3–10 mm., the half-obovate blades (5.7) 6.2–8.5 mm. long, 2.5–3.8 mm. wide, abruptly incurved through 80–90° (rarely less) into the bluntly deltoid apex; *anthers* (0.6) 0.7–0.85 (0.95) mm. long; *pod* erect, sessile, oblong-ellipsoid to narrowly oblong-ovoid, 1.2–2.5 cm. long, 5–8 mm. in diameter, straight or a trifle incurved, obtuse at base, contracted distally into a triangular-cuspidate, laterally compressed beak, otherwise obcompressed, with flattish ventral face keeled by the prominent, cordlike suture, and almost flat to widely and openly grooved dorsal face, the fleshy, green, glabrous valves becoming leathery or subligneous, stramineous, transversely rugulose and wrinkled lengthwise, commonly inflexed as a partial septum up to 1.4 mm. wide, but the septum sometimes vestigial or obsolete; *ovules* 23–30; *seeds* brown, chestnut-brown, or olivaceous, smooth but dull, 2.4–3.3 mm. long.—Collections: 59 (vi); representative: *Cusick 2374* (ND, ORE); *Maguire & Holmgren 26,637* (CAS, NY, UTC, WS); *Cronquist 6279* (ID, NY, SMU, TEX, WS), *6957* (ID, NY, RSA); *Ripley & Barneby 6115* (CAS, RSA), *6632* (CAS, RSA).

Stony hilltops, rough meadows, brushy hillsides and canyon benches, in grassland, sagebrush desert, and ascending rarely into the lower edge of the xeric pine forest, usually, perhaps exclusively on basaltic bedrock, (1600) 2000–5100 feet, common and locally plentiful in north transmontane Oregon, from the Blue Mountains in Baker County west to the Deschutes River, south to the Malheur Valley, Steens Mountain, and east into Owyhee County, Idaho.—Map No. 69.—Mid-April to June, the fruit persisting into winter.

ASTRAGALUS CONJUNCTUS (joined together, of the lower stipules) Wats. in Proc. Amer. Acad. 17: 371. 1882.—"In John Day Valley, Oregon (J. Howell, in May, 1880) and on sterile rocky ridges in Baker County, by W. C. Cusick, 1881."—Holotypus, *Howell 263*, GH! isotypi, from "Muddy Station, John Day Valley," ORE, WS! paratypi, *Cusick 948*, GH, ORE (from "s. of Baker City," fide Cusick)!—*A. reventus* var. *conjunctus* (Wats.) Jones, Contrib. West. Bot. 10: 61. 1902. *Phaca conjuncta* (Wats.) Piper in Contrib. U.S. Nat. Herb. 11 (Fl. Wash.): 373. 1906. *Tium conjunctum* (Wats.) Rydb. in N. Amer. Fl. 24: 393. 1929.

The growth-habit of the section, distinctive except in so far as it is shared by some *Reventi-arrecti*, is well illustrated by the average plant of *A. conjunctus*. The proper stems are composed of several inhibited lower internodes succeeded by one to four more strongly developed ones, and in consequence most of the leaves are disposed in a loose basal tuft. The leaves themselves are comparatively long, and the narrow distant or at least well-spaced leaflets give a peculiar sparse aspect to the herbage. The peduncles, of which the uppermost is often as thick as the true stem and at times may appear falsely terminal because of atrophy of the bud beyond it, are held stiffly erect at anthesis; together with the loose racemes they make up more than half (in most cases much more than half) the plant's total height. The general appearance suggests some acaulescent species of *Oxytropis* such as *O. Lambertii* Pursh, and the resemblance is accentuated in *A. conjunctus* and in the closely related *A. hoodianus* by the strictly erect pods of narrowly ellipsoid form.

The basalt milk-vetch, *A. conjunctus*, is most easily recognized in the flowering state, for the long, narrow blossoms with their cylindric calyx and usually lilac- or purple-tinged petals provide the most readily observed diagnostic characters. Mature specimens are likely to be confused with the narrow-fruiting forms of *A. reventiformis*, but this is apparently confined to the inner slope of the Cascades in Washington, well north of the range of *A. conjunctus*. The pod of the basalt milk-vetch varies a good deal in length and diameter and in development of the septum, which is sometimes lacking altogether, but the variations do not conform to any geographical pattern and must be attributed to inherited instability. Exceptionally large-

flowered plants (e. g. *Peck 26,188,* RSA) have been collected several times in the lower John Day Valley, but they do not form uniform or exclusive colonies.

Two collections from Wasco County, Oregon (near Boyd, *C. E. Hill 18, 19,* WS), in the hill country south of the Columbia River, show combined in one plant the narrow, short-toothed calyx of *A. conjunctus* and the pubescent pod of *A. hoodianus,* a species which becomes common a few miles northward along the river. These specimens suggest introgression between the two species, but are perhaps no more than a minor variant of *A. conjunctus.* The fruit of the related *A. Leibergi* varies from glabrous to strigulose, sometimes in a colony of otherwise like plants.

170. Astragalus hoodianus

Rather coarse, loosely tufted, with a thick, woody taproot and knotty, shortly forking caudex, pilosulous nearly throughout with fine, subappressed or loosely ascending hairs up to (0.5) 0.6–1 (1.1) mm. long, the herbage commonly gray- or silvery-silky, rarely greenish, the leaflets usually equally pubescent on both faces, sometimes glabrous above; *stems* several, erect or stiffly ascending from the decumbent base, stout, striate, 4–30 cm. long, composed of several congested lower internodes and ± 2–4 developed, often thicker ones (one of them up to 2.5–13 cm. long), inhibited beyond the first or second stout, elongate peduncle, the whole stem-axis nearly always less than half the full height of the plant; *stipules* submembranous, early becoming pallid or brownish, papery-scarious, ultimately fragile, (3) 5–11 mm. long, the lowest broad, obtuse, amplexicaul, at least in vernation connate through half or sometimes their whole length (the sheath sometimes ruptured in age), the upper ones lanceolate or deltoid-acuminate, semiamplexicaul, either all pubescent dorsally or the early ones glabrous; *leaves* (5) 7–20 cm. long, both cauline and gathered into radical tufts on short spurs, the latter with longer, slender petioles, the fully developed ones with 25–37 linear-elliptic or -oblong, oblanceolate, or sometimes ovate-oblong, obtuse, subacute, or rarely retuse, flat or loosely folded leaflets 5–27 mm. long, all commonly scattered along the rachis, disjointing readily when dry, the terminal one sometimes obscurely jointed; *peduncles* stiffly erect, stout, or the upper one quite slender and appearing terminal, 1.2–2.5 (3) dm. long, much surpassing the leaf; *racemes* at early anthesis rather dense, oval or oblong, (6) 10–30-flowered, soon elongating, narrow in fruit, the axis then (3) 5–18 cm. long; *bracts* membranous becoming scarious, lanceolate or linear-caudate, 2.5–9.5 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 1–1.7 mm., in fruit clavately thickened, 2–3.7 mm. long; *bracteoles* nearly always 2, up to 2 (3) mm. long; *calyx* (10) 11–15 mm. long, villous-pilosulous or pilose with loosely ascending or spreading, black, fuscous, or white, sometimes variously intermingled hairs, the slightly oblique disc (0.8) 1–1.4 mm. deep, the membranous, pallid tube (5.7) 6–7.9 mm. long, 3.6–4.8 mm. in diameter, the narrowly lanceolate or lance-caudate teeth (2.6) 4.6–6.7 (7.5) mm. long, all approximate toward the dorsal side, commonly arched outward or hooked at apex, the ventral sinus very broad, the whole becoming scarious, fragile but marcescent; *petals* cream-colored, immaculate; *banner* recurved through ± 45°, rhombic-oblanceolate or -elliptic, rather deeply notched, 18–23 mm. long, 6–7.9 mm. wide; *wings* 16.2–19.2 mm. long, the claws 7.5–10.1 mm., the narrowly oblong-oblanceolate or lance-oblong blades 9.5–12.1 mm. long, 2.4–3.2 mm. wide, straight or a trifle incurved below the obtuse, erose, or obliquely triangular and subacute apex; *keel* 13.4–15.6 mm. long, the claws 7.3–9.8 mm., the obliquely triangular blades 6.2–7.7 mm. long, 2.9–3.6 mm. wide, abruptly incurved through 85–90° to the sharply deltoid apex; *anthers* 0.6–0.85 mm. long; *pod* erect, sessile, broadly oblong-ovoid to narrowly oblong-ellipsoid or lance-oblong, (1.1) 1.4–2.2 cm. long, (4.5) 5–7.2 mm. in diameter, straight or nearly so, truncate or broadly cuneate at base, rather abruptly contracted distally into a triangular or triangular-

acuminate, rigidly cuspidate beak, decidedly obcompressed, low-carinate ventrally by the broad, prominent but obtuse suture, shallowly and openly groved dorsally, the lateral angles rounded, the green, fleshy valves becoming stiffly leathery or subligneous, brownish-stramineous, rugulose-reticulate, hirsutulous with rather stiff, ascending or rarely subappressed hairs up to (0.4) 0.5–1 mm. long, inflexed as a very narrow, sometimes subobsolete septum up to 0.7 (1) mm. wide; *seeds* olivaceous, sometimes with a black blotch at the hilum, or a black band across the middle, or soot-black throughout, smooth but dull, 2.3–3.1 mm. long.—Collections: 30 (i); representative: *J. & T. J. Howell 5388* (NY); *Suksdorf 2588, 5140, 6547, 9639* (WS), *482* (NY, WS); *J. W. Thompson 799, 10,379* (WTU); *Ripley & Barneby 10,816* (CAS, RSA).

Dry gravelly and grassy hillsides and canyon benches, mostly below 500 feet, occasionally a little higher, locally plentiful in and about the arid east end of the Columbia Gap, from near The Dalles downstream to Hood River, in Wasco and Hood River Counties, Oregon, and western Klickitat County, Washington.—Map No. 69.—Late March to June, the fruit long persisting.

ASTRAGALUS HOODIANUS (of Hood River) Howell in Erythea 1: 111. 1893 *("Hoodianus").* —"... apparently somewhat local in Wasco County, Oregon, where it grows on hills from Hood River to a point a few miles east of the Dalles, and also on the opposite side of the river."—Holotypus, labeled "Open pine woods east of Hood River, Oregon, May 8, 1885," *Thomas Howell 373,* ORE! isotypus, GH! A Howell spm. at WTU, lacking other data, is probably also isotypic.—*A. conjunctus* var. *hoodianus* (Howell) Jones, Contrib. West. Bot. 8: 9. 1898. *Phaca hoodiana* (Howell) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 373. 1906. *Cnemidophacos hoodianus* (Howell) Rydb. in N. Amer. Fl. 24: 285. 1929. *A. reventus* var. *hoodianus* (Howell) Peck, Man. Pl. Ore. 444. 1940.

Astragalus conjunctus var. *oxytropidoides* (resembling some species of *Oxytropis*) Jones in Proc. Calif. Acad. Sci. II, 5: 665. 1895.—"Near the Dalles, Oregon, May 8, 1885, Howell 798."—Holotypus, POM! isotypi, CAS, G, K, ND, NY, P, UC, US, WTU! This collection is probably part of the same set as the typus of *A. hoodianus,* distributed under another number. —*Tium oxytropidoides* (Jones) Rydb. in N. Amer. Fl. 24: 393. 1929 *("oxytropoides"). A. reventus* var. *oxytropidoides* (Jones) C. L. Hitchc. in Univ. Wash. Pub. Biol. 17: 257. 1961.

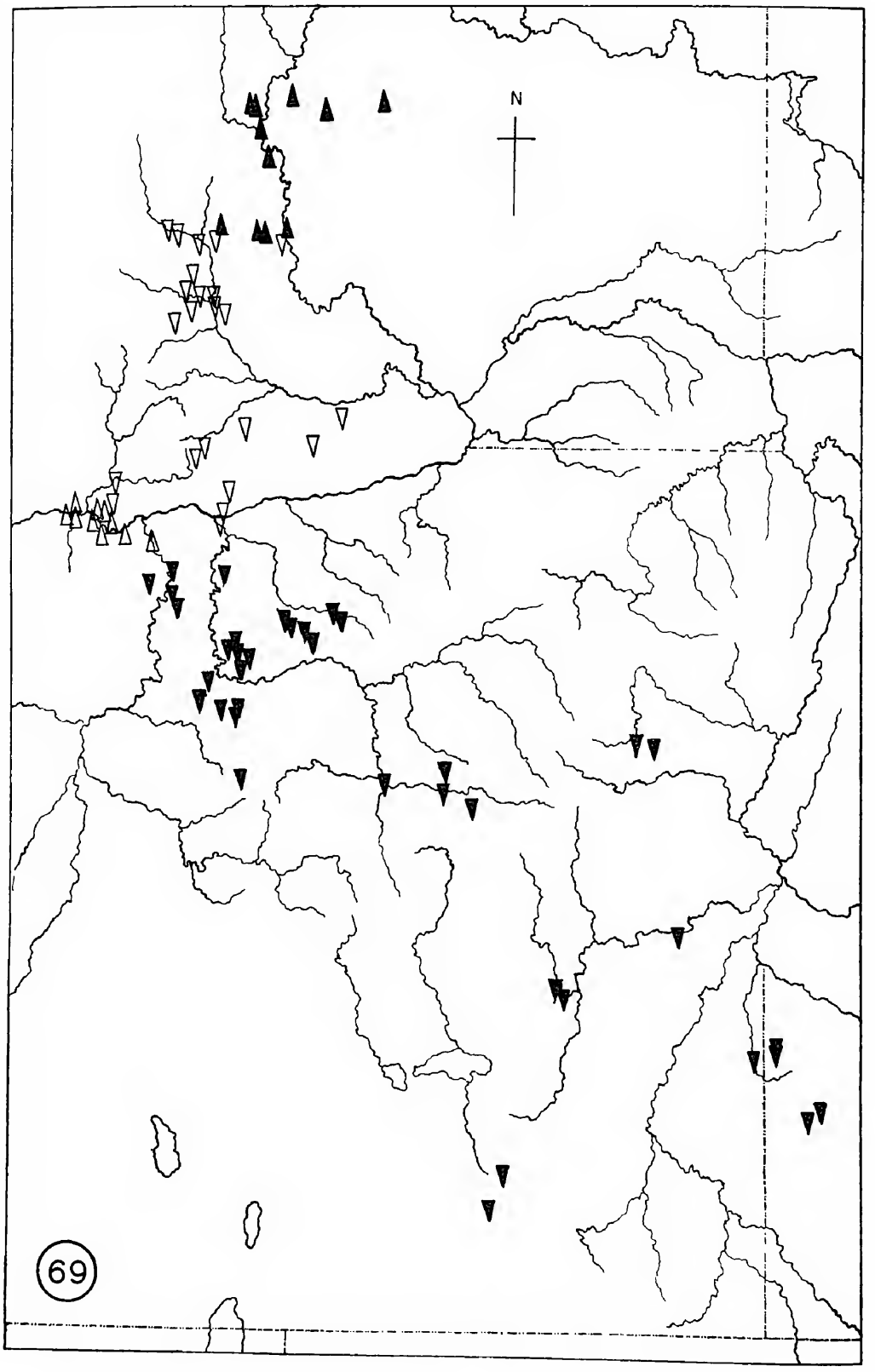
Cnemidophacos Knowlesianus (Dr. M. E. Knowles, who collected the species near The Dalles) Rydb. in N. Amer. Fl. 24: 284. 1929.—"Type collected on mountain sides, western Klickitat County, Washington, April 23 and in June, 1886, *Suksdorf 482* ..."—Cotypi, NY! isotypi, ND and (numbered 482b) WS!

The Hood River milk-vetch is closely related to *A. conjunctus* of which it might be loosely described as a robust, copiously pilosulous version. The longer and looser vesture provides an easily observed criterion at all stages of growth, but more valuable differential characters are found in the flowers. As compared with that of *A. conjunctus* the calyx of *A. hoodianus* is much more deeply cleft, so that the tube becomes campanulate and the (nearly always) much longer teeth are curved outward or distally hooked, not erect as in the commoner species. The pods of these two vicariant astragali are alike in form, varying within nearly the same limits of length and diameter, but that of the Hood River milk-vetch is pubescent and decidedly fewer-ovulate.

The pod of *A. hoodianus,* like that of *A. conjunctus,* varies from semibilocular to unilocular, a circumstance which compelled Rydberg to enter the species under two genera in *North American Flora.* An inconsequential minor variant, whose calyx bears some black hairs in contrast to the more usual white ones, was also segregated as *Cnemidophacos Knowlesianus;* this does not deserve taxonomic status. The type-sets of *A. hoodianus* and the independently described *A. conjunctus* var. *oxytropidoides* are in all probability parts of one large collection distributed under different serial numbers. All are dated May 8, 1885, and Jones early recognized the two propositions as taxonomically synonymous (Jones, Contrib. West. Bot. 8: 9. 1898).

171. ASTRAGALUS REVENTIFORMIS

Usually coarse and robust, sometimes low or slender, shortly caulescent or subacaulescent, with thick, woody taproot and knotty, shortly forking caudex, sparsely to quite densely strigulose-pilosulous with fine, filiform or slightly flattened,


N
69

straight or nearly straight, appressed or narrowly ascending hairs up to (0.4) 0.5–0.75 mm. long, the herbage dark green, gray-green, or rarely silvery, the leaflets mostly glabrescent or glabrous above, sometimes equally pubescent on both sides; *stems* several or numerous, often almost 0, concealed by imbricated stipules, but as often developed and 2–12 (21) cm. long, composed of up to 5 visible internodes, one of them (usually that preceding the first peduncle) longer than the rest and up to 6 (7) cm. long (mostly less), the main axis in any case shorter than the longest peduncle and forming less than half the plant's full height; *stipules* 2.5–7 mm. long, papery-membranous, pallid or purplish, triangular or triangular-acuminate, all (or at least the lowest) amplexicaul and connate through half to nearly their whole length into a sheath, the upper ones sometimes only very shortly united at base, the sheath in any case sometimes ruptured in age by expansion of the stem, all either glabrous or pubescent dorsally; *leaves* loosely tufted, (6.5) 8–22 (30) cm. long, with slender, rarely stout and rigid, often basally persistent petioles and (13) 17–27 (33) linear-oblong, lanceolate, lance-elliptic, or oval-oblong, mostly obtuse or truncate-emarginate, sometimes mucronulate or acute, flat or folded, commonly scattered and often distant, at length deciduous leaflets 4–21 (25) mm. long; *peduncles* stiffly erect, but sometimes weighed down finally by the heavy fruits, (0.7) 1–3 dm. long, mostly surpassing the leaves; *racemes* (7) 10–19-flowered, rather dense at early anthesis but early elongating and loose, the flowers at first ascending, loosely spreading or declined at full anthesis, the axis (2.5) 4–12 cm. long in fruit; *bracts* membranous, lanceolate, 1.5–4.5 (6) mm. long; *pedicels* at full anthesis slender, somewhat arched, 0.9–2 mm. long, in fruit erect, clavately thickened, 2.7–6 mm. long; *bracteoles* nearly always 2; *calyx* (7.8) 8–12.2 mm. long, pilosulous with ascending, black, fuscous, or partly white hairs, the slightly oblique disc (0.8) 1–1.6 mm. deep, the tube (4.7) 5.3–7.5 mm. long, 3.3–4.7 (5.1) mm. in diameter, the lance-subulate teeth (2.4) 2.7–5.1 mm. long, the ventral pair usually broadest and sometimes a little the longest, the whole becoming papery-scarious, irregularly circumscissile; *petals* white or whitish, drying yellowish, immaculate, or the keel-tip sometimes lilac; *banner* strongly recurved through ± 90°, oblong-oblanceolate, rhombic-oblanceolate, -elliptic, oblong-ovate, or somewhat quadrately ovate-cuneate, usually deeply notched, (13.2) 14–20.7 mm. long 5–9.8 mm. wide; *wings* (13.2) 14–17.8 mm. long, the claws (5.3) 5.9–7.6 mm., the elliptic-oblanceolate to broadly half-obovate, erose or obliquely emarginate blades 9–12 mm. long, 2.8–5.5 mm. wide; *keel* 10–13 (13.7) mm. long, the claws (4.8) 5.3–7.5 mm., the half-obovate blades (5.4) 6–7.4 mm. long, (2.7) 3–3.9 mm. wide, rather abruptly incurved through 85–95° to the sharply or bluntly deltoid apex; *anthers* 0.6–0.85 (1) mm. long; *pod* erect, sessile, varying from plumply ovoid-acuminate to oblong-ellipsoid, (1) 1.5–2.2 cm. long, (5) 6–11 mm. in diameter, straight or a trifle incurved, obtuse or subtruncate at base, tapering or abruptly contracted distally into a triangular-acuminate, rigidly cuspidate beak, otherwise a little obcompressed but (when broad, as most often) strongly bircarinate by the thickened, obtuse but salient, cordlike ventral and the narrower, often acute and winglike, undulate dorsal suture or (when narrower) ventrally carinate but dorsally flattened or even widely and shallowly sulcate, the ventrally carinate but dorsally flattened or even widely and shallowly sulcate, the thick, fleshy, green, glabrous valves becoming brownish, stiffly leathery or woody, transversely rugulose-reticulate and often wrinkled lengthwise, not inflexed, or inflexed as a narrow septum up to 0.6 (2) mm. wide; *ovules* (20) 22–35; *seeds* brown or olivaceous, often purple-speckled, rarely dark purplish-black, smooth

Map No. 69. Interior Oregon and parts of adjacent states. Range of ◒ *A. conjunctus*; of ◓ *A. hoodianus*; of ◔ *A. reventiformis*; and of ◕ *A. Leibergi*.

but dull, 1.2–3.6 mm. long.—Collections: 33 (i); representative: *Suksdorf 853* (ND, NY, WS); *Hitchcock & Muhlick 8172* (CAS, WS, WTU); *Hitchcock & Marsh 3306, 3313* (CAS, WS, WTU); *J. W. Thompson 11,518* (CAS, WS, WTU); *L. F. Henderson 5100* (CAS, DS); *Ripley & Barneby 10,846* (CAS, GH, RSA, WS).

Dry grassy or gravelly hillsides, stony flats, and scablands, often among sagebrush, usually on basalt bedrock but sometimes in alluvial loam of spring-moist bottomlands, 1050-4000 feet, ascending rarely to open mountain crests (possibly granitic) at 5000 feet, commonly and locally plentiful on the eastern slope and foothills of the Cascade Range drained by the Yakima River, from near Ellensburg south to the Horse Heaven and Klickitat Hills in southwestern transmontane Washington, extending just across the Columbia River to its left bank in northern Sherman County, Oregon.—Map No. 69.—April to June, the flowers soon past but the fruits long persisting.

ASTRAGALUS REVENTIFORMIS (Rydb.) Barneby in Amer. Midl. Nat. 55: 492. 1956, based on *Cnemidophacos reventiformis* (resembling *A. reventus*) Rydb. in N. Amer. Fl. 24: 284. 1929.—"Type collected at Klickitat, Washington, April 26, 1882 . . . "—Holotypus, collected by Thomas Howell, NY! isotypi, ORE, WS!

Astragalus reventus var. *Canbyi* (William Marriott Canby, 1831–1904) Jones, Contrib. West. Bot. 8: 11. 1898.—"Yakima region, Wash. Brandegee No. 36. 1882."—Holotypus, bearing in a packet Jones's annotation label "*A. Canbyi*, sp. nov.," UC!

The pod of the Yakima milk-vetch, *A. reventiformis*, is subject to much variation in size and outline. Most frequently it is broadly and plumply ovoid-acuminate, girdled when ripe around its long diameter by the salient sutures which form an almost winglike ridge; but the broadest forms pass by imperceptible degrees into narrower ones, elliptic-oblong in profile and carinate only by the ventral suture, the dorsal face becoming flat or even shallowly grooved. Pods of the latter sort are scarcely distinguishable from those of *A. conjunctus*, and the two species are difficult to separate once the flowers and circumscissile calyx have fallen. There is some reason to suspect that a narrow pod is associated with a more nearly montane habitat (cf. *J. W. Thompson 14,819* from Cleman Mt., Yakima County, CAS, RSA, WIS, WS, WTU), but this is as yet inconclusive. In any case the similarity in the fruit harmonizes with other evidence that *A. reventiformis* is much more closely related to *A. conjunctus* than to *A. reventus*, with which Jones confused it and with which Rydberg associated it in *Cnemidophacos*. In all three species a septum may be either present or absent, and this character has no taxonomic value in the group. When Jones described *A. reventus* var. *Canbyi*, he particularly singled out the connate stipules as the principal diagnostic feature of his variety, and this remains an important clue to the affinities of the species.

Flowering specimens of *A. reventiformis* are instantly recognized. The petals are a little shorter than in *A. conjunctus*, but are almost always proportionately broader, and the banner is much further recurved at full anthesis. The campanulate calyx-tube and relatively long teeth are characteristic.

172. ASTRAGALUS LEIBERGI

Tufted, shortly caulescent or subacaulescent, with a thick woody taproot and sometimes loosely forking, multicipital caudex often beset with stiff bases of marcescent petioles, strigulose nearly throughout with appressed and narrowly ascending, mostly straight hairs up to 0.45–0.65 mm. long, the herbage silky-cinereous becoming greenish in age, rarely green from the first, the leaflets either equally pubescent on both sides or sometimes medially glabrescent above; *stems* erect, 1–10, (exceptionally 5–25) cm. long, composed of 1–4 (7) developed internodes, the longest (usually that preceding the first peduncle) up to 0.5–5 (7) cm. long, the whole axis nearly always shorter than the leaves and peduncles; *stipules* scarious, pallid, becoming fragile and easily ruptured, at least the lowest and often all fully amplexicaul and connate into a bidentate sheath, the median and upper ones sometimes only obscurely united at base, the uppermost sometimes free from the first, the lance-triangular blades then deflexed; *leaves* often all subradical

and tufted, but some not rarely cauline and then more shortly petioled or subsessile, (5) 8–20 (28) cm. long, with rather stiff petioles and (11) 15–27 (31) often distantly and irregularly inserted, commonly linear or narrowly lance-elliptic (and less than 3 mm. wide), rarely lance-oblong to oblong (and up to 7 mm. wide), obtuse or subacute, folded or more rarely flat leaflets 2–25 (38) mm. long, disjointing in age; *peduncles* stout, erect unless weighed down by the heavy fruits, (6) 10–28 cm. long, equaling or surpassing the leaves; *racemes* loosely 7–20-flowered, the flowers nodding at anthesis, erect soon thereafter, the axis early elongating, 4–17 cm. long in fruit; *bracts* membranous, ovate, lanceolate, or linear-caudate, 2–4.5 mm. long; *pedicels* at anthesis slender, spreading or arched outward, 0.8–1.5 (2) mm. long, in fruit narrowly ascending, straight, clavately thickened, (2) 2.5–4.5 mm. long; *bracteoles* commonly 2; *calyx* 5.3–8.6 (11.2) mm. long, loosely strigulose or pliosulous with black or largely black hairs, the slightly oblique disc 0.9–2 mm. deep, the membranous, pallid, campanulate tube 3.2–4.9 (5.8) mm. long, (2.8) 3–4 mm. in diameter, the subulate or lance-subulate teeth 1.6–3.8 mm. long, the whole becoming papery, marcescent unruptured; *petals* whitish, immaculate; *banner* recurved through 90° (further in withering), ovate- or oblong-cuneate, broadly and shallowly notched, (10.8) 11.6–16.4 mm. long, 5.8–8 mm. wide; *wings* (0.6 mm. shorter to 1.3 mm. longer than the banner) 10.6–16.9 mm. long, the claws (4) 4.8–7 mm., the obliquely oblanceolate or oblong-elliptic, erose or shallowly notched blades (7.7) 8.2–10.5 mm. long, 2.6–3.6 (4) mm. wide; *keel* (8.9) 9.3–12.6 mm. long, the claws (4.1) 4.8–7 mm., the half-obovate or lunately half-circular blades 5.4–6 mm. long, 2.9–3.9 mm. wide, incurved through 95–130° to the bluntly deltoid, sometimes obscurely porrect apex; *anthers* 0.5–0.75 (0.85) mm. long; *pod* stiffly erect or ascending at a narrow angle, stipitate, the stout stipe 3–5 (8) mm. long, the oblong-ellipsoid body 1.6–2.7 cm. long, 4–7.5 mm. in diameter, nearly straight or gently incurved, cuneate, abruptly rounded, or tapering at base, contracted distally into a compressed, narrowly triangular, cuspidate beak, otherwise obcompressed-triquetrous, with strongly convex lateral and shallowly open-sulcate or depressed dorsal face, keeled ventrally by the prominent, thickened suture, the smooth, green, fleshy, glabrous or minutely black- or white-strigulose valves becoming brownish, stiffly leathery or woody, transversely impressed-reticulate and often wrinkled lengthwise, inflexed as a partial, sometimes obscure septum 0.4–1.3 mm. wide; *ovules* 23–32; *seeds* dark brown, green mottled with blackish-violet, or sometimes nearly black, smooth or nearly so, 2.2–2.9 mm. long.—Collections: 20 (iv); representative: *Otis 2231* (WS WTU); *C. H. Ward 314* (CAS, NY, SMU), *11,501* (NY, WS): *Brandegee 724* (NY); *Ripley & Barneby 10,857* (NY, RSA), *10,868, 10,905* (CAS, RSA).

Low hills and plains, commonly in sagebrush scabland on basalt bedrock, occasional in the Cascade foothills on grassy north slopes in open pine forest on granite or serpentine, 1000–2300 (3000) feet, locally plentiful in the valley of the Columbia River in Chelan, Douglas, and Kittitas Counties, central transmontane Washington.—Map No. 69.—Mid-April to June, the fruit long persisting.

ASTRAGALUS LEIBERGI (John Bernhard Leiberg, 1853–1913) Jones in Proc. Calif. Acad. Sci. II, 5: 663. 1895.—"No. 354, Sandberg and Leiberg, Egbert Spring, Douglas County, Washington, alt. 3500 [more nearly 2100] ft., July 1, 1893 . . ."—Holotypus, US! isotypi, GH, MINN, US, WS, WTU!—*A. arrectus* var. *Leibergi* (Jones) Jones, Contrib. West. Bot. **10**: 68. 1902. *Phaca arrecta* var. *Leibergi* (Jones) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 372. 1906 (*"leibergii"*). *Tium Leibergi* (Jones) Rydb. in N. Amer. Fl. 24: 392. 1929.

The Leiberg milk-vetch stands alone in its section on account of its stipitate pod which forms early in the season and can often be found well preserved on dead stems of the previous year. In Kittitas County its range overlaps that of *A. reventiformis* to some extent, but flower-

ing material of doubtful identify from this area can be distinguished by floral characters, the petals of *A. Leibergi* being less strongly, sometimes irregularly graduated and its keel-tip greatly incurved. Otherwise the Leiberg milk-vetch has been confused only with *A. arrectus*, a species similar in the form of the pod but differing in its taller stems, free stipules, and slightly smaller flowers which ascend from the raceme at anthesis. Despite the resemblance in the fruits, these two astragali are not intimately related, their close affinities leading off in divergent directions, *A. arrectus* being connected through *A. riparius* with sessile pod but similarly modified flowers to the genuine *Reventi-arrecti*, whereas *A. Leibergi* has all the essential characters of sect. *Conjuncti*. The carpological similarity must be due to evolutionary convergence.

Characters of a robust caulescent phase of *A. Leibergi*, with broad leaflets of relatively thin texture, known only from partly serpentinized soils in pine forest along Swakane Canyon, Chelan County (cf. *C. L. Hitchcock 17,337*, RSA, WTU! *Ripley & Barneby 10,897*, CAS, GH, RSA, US, already mentioned by Barneby, 1956, p. 493) have been included for the present in the description of the species. The typical form of *A. Leibergi* is characteristically a plant of basaltic scablands so that the Swakane Canyon variant, granted a more extensive range within a consistently different environment, may deserve recognition as a variety. Its discovery in other canyons leading down into the Columbia will be awaited with interest.

The Leiberg milk-vetch was first collected by T. S. Brandegee while in eastern Washington with the Northwestern Survey in 1882. The specimen in the Brandegee herbarium (UC) lacks precise locality, but bears an unpublished binomial in Jones's autograph.

XLVI. Sectio HESPERONIX

Caulescent perennials, with superficial or shallowly buried root-crown; *vesture* basifixed; *stipules* scarious, at least the lowest connate-sheathing; leaves imparipinnate, with ± 17–25 leaflets; *flowers* rather shortly racemose, ascending or spreading at full anthesis, of moderate size, the banner 13–17.5 mm. long; *calyx-tube* campanulate; *petals* whitish or lilac-tinged, regularly graduated, the banner recurved through ± 40°, the keel-tip obtuse; *pod* either ascending or declined, stipitate, continuous with the receptacle, falling tardily with the disjointing pedicel, the body inflated, somewhat obcompressed, fully bilocular below the beak, the valves papery; *dehiscence* apical, tardy, after falling; *ovules* 12–21.—Sp. 1, xerophyte, of the timber belt on the west slope of the Sierra Nevada, California, extending east of the crest around Lake Tahoe as far as Mount Rose, Nevada.

Astragalus sect. Hesperonix (Rydb.), stat. nov., based on *Hesperonix* Rydb. in N. Amer. Fl. 24: 438. 1929 & Amer. Jour. Bot. 17: 234, Pl. XVII, fig. Z. 1930.—Generitypus: *H. Bolanderi* (Gray) Rydb. = *A. Bolanderi* Gray.

The single species of sect. *Hesperonix* is taxonomically and physiologically isolated. It has been associated in the past (Jones, 1923, p. 164; Rydberg, 1929, l.c.) with *A. vallaris* and *A. cimae*, species of sect. *Malaci* native to the interior deserts. These are fortuitously similar to *A. Bolanderi* in some aspects of the fruits, but are not close relatives or even closely similar in other respects. The sect. *Conjuncti* might be modified to accommodate *A. Bolanderi*, but the genuine members differ greatly in their solid thick-walled pods which remain attached to the raceme on their thickened pedicels until dehiscence is past. Furthermore, they have a peculiar growth-habit due to the shortness of the proper stems in proportion to the erect subscapiform peduncles. The closest affinity of *A. Bolanderi* lies very probably with the following sect. *Bicristati*, similar in habit of growth and with pods deciduous in the same manner and dehiscent on the ground. The two species of sect. *Bicristati* are distributed locally, one at each end of the range of *A. Bolanderi*, and occur in nearly similar environments. They differ from sect. *Hesperonix* chiefly in the unilocular pods of fleshy texture.

173. Astragalus Bolanderi

Robust or sometimes quite slender, but always stiff and rather sparsely leafy, with a thick, woody taproot and knotty root-crown or loosely forking caudex, villosulous with fine, ascending, incumbent, or curly, exceptionally subappressed and wavy hairs up to 0.4–0.7 (0.8) mm. long, the stems thinly so and usually

glabrous toward the base, the herbage either greenish or canescent, the leaflets equally pubescent on both sides or more thinly so above; *stems* several or numerous, erect, or decumbent with ascending tips, (1) 1.5–4 (4.5) dm. long, slender and leafless at base, becoming stouter and striate upward, stramineous in age, simple or (in vigorous plants) branched or spurred at 1–3 nodes preceding the first peduncle, commonly zigzag distally; *stipules* scarious, pallid (or early becoming so), (1.5) 2–6 mm. long, the lowest united through half to nearly their whole length into a rather loose, obtusely bidentate (fragile and sometimes ultimately ruptured) sheath, the median and upper ones decurrent around at least half the stem's circumference, free or united by a low collar or stipular line, the blades mostly reflexed, all glabrous dorsally, ciliate, the margins beset with a few minute processes; *leaves* (3) 4–12 (16) cm. long, the lower ones shortly petioled, the upper sessile or nearly so, with rather stiff rachis and (13) 17–25 (27) usually scattered, narrowly oblong-elliptic, oblanceolate, linear-oblong, or rarely oblong-obovate, acute, rarely subobtuse or (exceptionally, in some lower leaves) retuse, folded or less often flat leaflets (3) 5–20 (23) mm. long, all commonly carinate dorsally by the midrib which runs out into a callous mucro; *peduncles* stiffly erect or narrowly ascending, (3) 4–8 cm. long, usually shorter than the leaf; *racemes* shortly and rather closely (5) 8–18-flowered, the axis little elongating, (0.5) 1–3 (5) cm. long in fruit; *bracts* scarious, ovate or lanceolate, 1.2–3 mm. long; *pedicels* at anthesis ascending, slender, (0.8) 1–2 (2.7) mm. long, in fruit a little thickened, straight and ascending, straight and divaricate, or commonly arched outward, (1.1) 1.5–2.5 (3.5) mm. long; *bracteoles* 0–2, minute when present; *calyx* (6.4) 7–12 (13) mm. long, villosulous (at times thinly so) with mixed black and white, white and fuscous, rarely all white hairs, the subsymmetric disc (0.9) 1.1–1.8 mm. deep, the tube (4.5) 4.8–6.3 (6.8) mm. long, 3–4.3 mm. in diameter, the subulate or lance-subulate teeth (1.8) 2.5–5.3 (6.2) mm. long, all subequal but the ventral pair usually broadest (the dorsal one sometimes shortest), the whole becoming papery, marcescent unruptured; *petals* whitish, perhaps sometimes faintly lilac-tinged, drying yellowish; *banner* rhombic-elliptic or -obovate, 13–17.6 mm. long, 5.2–8 mm. wide; *wings* 12–15.8 mm. long, the claws 5.8–7.8 mm., the narrowly lanceolate or lance-elliptic, obtuse or rarely subemarginate, straight or slightly incurved blades 7.4–9.2 mm. long, 1.9–3 mm. wide, the narrow tips often obscurely erose and twisted; *keel* (9.8) 10–12.4 mm. long, the claws 5.7–7.7 mm., the half-obovate blades 4.2–5.6 mm. long, (2.4) 2.7–3.2 mm. wide, rather abruptly incurved through 95–100° to the bluntly deltoid apex; *anthers* 0.45–0.65 (0.7) mm. long; *pod* variably oriented, stipitate, the straight or slightly incurved, filiform but rigid or upwardly thickened stipe (4) 5–12 mm. long, ascending, divaricately spreading, or even a little declined from the raceme-axis, the very obliquely ovoid or ovoid-acuminate, inflated but scarcely bladdery body set at an angle to the stipe and thus so strongly incurved from its insertion as to bring the beak vertically erect or more often directed inward toward the axis, (1) 1.3–2.4 (3.2) cm. long, 6–12 mm. in diameter, truncate or obcordate (exceptionally broadly cuneate) at base, a little dorsiventrally compressed and sulcate along both sutures (but more deeply so ventrally), passing distally into a deltoid or triangular-acuminate, laterally flattened, cuspidate beak, the ventral suture concave and the dorsal one (filiform but often undulate) strongly convex as viewed in profile, the lateral angles plumply rounded, the thinly fleshy, green, glabrous valves becoming stramineous or brownish, delicately reticulate, inflexed below the unilocular beak as a complete septum 3–6 mm. wide, the endocarp also inwardly dilated along both sides of the seminiferous portion of the ventral suture to form hollow wings 0.5–1.2 mm. in diameter embracing the funicules,

these becoming narrow, tubular cavities contained within the walls of the ripe fruit; *seeds* brown, sometimes purple-speckled, smooth, minutely punctate, or sparsely pitted, dull, 2–3.1 mm. long.—Collections: 30 (o); representative: *Eggleston 7661* (NY); *G. T. Robbins 1358* (CAS, NY); *Peirson 12,869* (CAS, RSA); *J. T. Howell 492, 17,290, 17,858, 25,122* (CAS); *Ferris & Lorraine 10,826, 10,952* (DS, SMU, WS).

Dry sandy or stony margins of meadows, mountain flats, lake shores, and openings in coniferous forest, mostly on granite, widely dispersed and locally plentiful between (5200, northward) 6500 and 10,000 (acc. Jepson 10,800) feet along the west slope of the Sierra Nevada, California, from western Plumas County (Spanish Peak and vicinity) south to the Greenhorn Range (Baker Ridge) in the Kern Valley, southern Tulare County, extending east through Eldorado County to Lake Tahoe, and to Mount Rose, southern Washoe County, Nevada.—Map No. 50.—June to September.

ASTRAGALUS BOLANDERI (Henry Nicholas Bolander, 1831–1897, botanist with the California Geological Survey in 1865–1870) Gray in Proc. Amer. Acad. 7: 337. 1867.—"... at Ostrander's Ranch, Yosemite Valley, Bolander."—Holotypus, *Bolander 5021,* collected in 1866, GH! isotypi, P (fragm.), US!—*Tragacantha Bolanderi* (Gray) O. Kze., Rev. Gen. 943. 1891. *Hesperonix Bolanderi* (Gray) Rydb. in N. Amer. Fl. 24: 440. 1929.

Astragalus supervacaneus (empty distally, of the pod's unilocular beak) Greene in Erythea 1: 221. 1893.—"At middle elevations in the mountains of Fresno Co., Calif.; communicated by Mr. Frank Nutting."—Holotypus, collected in 1893, ND!

The Bolander milk-vetch is the only astragalus found along the west slope of the Sierra, at 6500–10,000 feet, between the valleys of the Kern and Yuba Rivers. It is common in its zone of occurrence where Jepson has described it as forming extensive colonies in sandy meadows and openings of *Abies concolor* forest, often associated with *Eriogonum nudum.* At its northern limit its range overlaps that of *A. Webberi,* which is easily distinguished by its fine, satiny pubescence and sessile, solid pod of fleshy, when ripe almost woody texture. In the Tahoe region, which *A. Bolanderi* had most probably reached by eastward migration across the relatively low passes near the headwaters of the American River, it has invaded an area rich in *Astragali* of several different groups; here the fruit may be required for identification. The pod of *A. Bolanderi* is a remarkable one, in some respects unique. The slender but stiff stipe is variably oriented, either spreading, ascending or declined, but the body is set upon it obliquely and is furthermore so strongly incurved as to bring the beak to an attitude vertical to the ground or, more often, pointing inward toward the raceme-axis. The body of the pod is decidedly inflated, of rather firmly papery texture, hardly to be described as bladdery. The structure of the funicular flange is quite unusual; and the number of ovules and seeds unexpectedly low in proportion to the size of the fruit. In general appearance the Bolander milk-vetch is rather sparsely leafy, its habit of growth stiff and awkward. The pubescence of the leaves varies in density, but is usually sparse; the gray-villosulous forms collected in Nevada County (e. g., *Sonne 13,* ND) seem to represent no more than a minor variant.

The Bolander milk-vetch was first collected in Yosemite Valley by Dr. Torrey in 1865, and somewhere in the Sierra as early as 1857 by Thomas Bridges (*No. 46,* GH).

XLVII [redacted] Sectio BICRISTATI

Caulescent perennials, with diffuse stems arising from a shallowly buried root-crown; *vesture* basifixed; *stipules* dimorphic, the lowest small, connate-amplexicaul, the upper ones free; *leaves* imparipinnate, with 13–21 (25) leaflets, the terminal one rarely decurrent; *flowers* loosely racemose, ascending, of moderate size, the banner 15–19.5 mm. long; *calyx-tube* deeply campanulate or subcylindric; *petals* whitish, the banner recurved through 45–75°, the immaculate keel-tip deltoid; *pod* ascending or pendulous, sessile or stipitate, persistent on the receptacle and falling together with the tardily disjointing pedicel, the body large, fleshy, ± dorsiventrally compressed below the beak, the thick sutures salient in age, the valves becoming stiffly leathery or woody, not or scarcely inflexed; *ovules* 20–33.—

Spp. 2, xerophytes, one of the northern Sierra Nevada, the other of the transverse ranges in southern California.

The pair of rare, sharply definite *Astragali* brought together here to form sect. *Bicristati* are similarly organized up to the fruits, but these are so highly differentiated in orientation, form, and dehiscence as to entitle each species to a monotypic subsection. A relationship between them was perceived by Jepson (1936, p. 365), but the monographers have treated them as members (although clearly anomalous members) of widely separated groups. Thus Jones placed *A. bicristatus* in his polyphyletic sect. *Podosclerocarpi* directly following *A. sclerocarpus,* but it may well have been tucked in at this place in the Revision as a last resort, for it is omitted from the sectional key. Rydberg (1924, p. 19) moved *A. bicristatus* and *A. sclerocarpus* together to *Homalobus* sect. *Collini,* although he remarked that the former did not fit comfortably into the genus *Homalobus.* Jones (1923, p. 202) conceived of *A. Webberi* as "probably no more than a marked form of *A. cibarius,*" which he had misplaced in sect. *Argophylli;* this pair was subsequently transferred by Rydberg (1925, p. 151) to an equivalent subsect. in *Xylophacos.* The useful differential characters of sect. *Bicristati* as defined above are the shallowly buried root-crown, connate primary stipules, ascending flowers, and especially the large, fleshy and ultimately subligneous, dorsiventrally compressed, essentially unilocular pods which fall together with the tardily disjointing pedicels. The section thus differs from the *Podosclerocarpi* (sens. restr.) and with few but irrelevant exceptions from the *Argophylli* in the union of the lower pairs of stipules and in the position of the resting-buds; and furthermore, from the first-named in the direction of the fruit's compression and from the second in its method of falling. The affinities of *A. bicristatus,* of which the pod is highly modified, would be difficult to trace if we lacked *A. Webberi,* through which a connection, clear if not especially close, to sect. *Conjuncti* can be assumed. The pod of *A. Webberi* is closely similar to that of several *Conjuncti,* from which sect. *Bicristati* differs principally in its habit of growth and ultimate disarticulation of the fertile pedicels.

Key to the Subsections of Sect. Bicristati

1. Pod pendulous, long-stipitate, dehiscent through the stipe; *calyx* withering-persistent; transverse ranges of s. California ..... XLVII (ii). Subsect. *Bicristati*
1. Pod ascending (humistrate), sessile, dehiscent through the beak; *calyx* becoming scarious, fragile, circumscissile; n. Sierra Nevada, California ..... XLVII (i). Subsect. *Webberani*

XLVII (i). Subsectio Webberani

Characters as given in the key.—Sp. 1, of the Sierra Nevada, California.

Astragalus sect. Bicristati subsect. Webberani, subsect. nov., legumine sessili, adscendenti, apice tantum dehiscenti, necnon calyce demum circumscisso deciduo a *Bicristatis* veris dissimiles.—Sp. unica: *A. Webberi* Gray.

174. Astragalus Webberi

Rather robust, diffuse, leafy, densely strigulose nearly throughout with fine, straight, appressed (and often a few narrowly ascending) hairs up to 0.35–0.6 (0.7) mm. long, the herbage greenish-canescent and often satiny, sometimes becoming silvery in age, the leaflets equally pubescent on both sides, the inflorescence ± dark hairy; *stems* numerous, decumbent and weakly ascending, (1.5) 2.5–5 dm. long, slender, leafless, purplish at base, subterranean for a space of (0) 1–5.5 cm., stouter upon emergence, simple or rarely spurred at 1–2 nodes preceding the first peduncle, floriferous from near or below the middle; *stipules* (1.5) 2–7 mm. long, dimorphic, those at the lowest nodes amplexicaul and connate into a campanulate, papery-scarious, bidentate sheath (sometimes ruptured in age), the median and upper ones herbaceous and longer, ovate- or triangular-acuminate, or lanceolate, the squarrose or deflexed blades pubescent both within and without, their margins ciliate and often beset with a few minute processes; *leaves* (2.5) 4–13 (15) cm. long, shortly petioled or the upper ones subsessile, with (9) 15–21 (25) broadly to narrowly oblanceolate or elliptic-oblanceolate, obtuse, shallowly retuse, truncate and mucronulate, or subacute, flat leaflets (0.5) 1–2.5 (3.5) cm. long; *peduncles*

rather stout, (4.5) 6–15 cm. long, incurved-ascending at anthesis, reclinate in fruit; *racemes* loosely 6–12 (14)-flowered, the flowers ascending or somewhat spreading in age, the axis 2.5–10 cm. long in fruit; *bracts* submembranous, pallid or rarely purplish, lanceolate or ovate-acuminate, 1.3–4.5 mm. long; *pedicels* rather stout, ascending or a little arched outward, at anthesis (1) 1.2–2 mm., in fruit thickened, 2.2–3.5 mm. long; *bracteoles* 0–2; *calyx* 8.8–11.8 mm. long, loosely strigulose with mixed black or fuscous and pallid hairs, the strongly oblique or subsymmetric disc 1.3–2.2 mm. deep, the membranous, deeply campanulate or subcylindric tube 6.3–7.5 mm. long 2.9–4 mm. in diameter, the lance-subulate teeth 2.5–4.3 mm. long; *petals* ochroleucous, immaculate; *banner* evenly but quite strongly recurved (through 50–75°), narrowly to broadly rhombic-elliptic or -oblanceolate, notched or subentire at apex, 15.4–18.8 mm. long, 6–8.6 mm. wide; *wings* 13.2–16.8 mm. long, the claws 6.4–8.1 mm., the oblong-oblanceolate or linear-oblong, obtuse, truncate, or erose-emarginate, slightly incurved blades 7.7–10.4 mm. long, 2.5–3.8 mm. wide; *keel* 11.4–13.7 mm. long, the half-obovate blades 5.4–7 mm. long, 2.8–3.8 mm. wide, abruptly incurved through 90–95° to the rounded or sharply deltoid apex; *anthers* (0.6) 0.7–1.05 mm. long; *pod* ascending or loosely spreading-ascending (humistrate), sessile, obliquely oblong-ellipsoid, slightly incurved, (2) 2.5–3.5 cm. long, (7) 8–12 mm. in diameter, rounded or broadly cuneate at base, contracted distally into a short, triangular- or deltoid-acuminate, stiffly short-cuspidate, laterally compressed beak, otherwise a little obcompressed, obtusely carinate ventrally by the salient, cordlike suture, the dorsal face low-convex, flat or a trifle depressed, also carinate by a more slender, often undulate suture, the thick, fleshy, green or red-spotted, glabrous valves becoming brownish-stramineous, stiffly leathery or almost woody, reticulate and often rugulose on the angles, wrinkled lengthwise, not inflexed, or inflexed as a rudimentary septum up to 1.5 mm. wide; *ovules* 20–26; *seeds* brown or greenish-brown, sparsely pitted, dull, 3.1–4 mm. long.—Collections: 8(ii); representative: *Mrs. Clemens* (from Taylorville) *in Sept. and May, 1920* (CAS, NY); *Barneby & Howell 11,478* (CAS, NY, POM, RSA); *W. G. Follett* (from Virgilia) *in 1930* (CAS).

Open brushy slopes and flats in xeric pine forest or mixed pine and oak forest, 2700–3550 feet, possibly higher (to 5000 feet acc. Jepson), local but locally plentiful about the headwaters of the Feather River in Plumas and perhaps adjoining Sierra County, California.—Map. No. 70.—May to July, the fruit long persisting.

ASTRAGALUS WEBBERI (a friend of Lemmon, perhaps connected with the California Geological Survey) Gray ap. Brew. & Wats., Bot. Calif. 1: 154. 1876.—"Indian and Sierra Valley, in the northeastern part of the Sierra Nevada, *Lemmon, Mrs. Pulsifer-Ames.*"—Holotypus (*Lemmon,* from Sierra County in 1874), GH (2 sheets); paratypus (*Mrs. Ames* from Plumas County), GH!—Collections of Lemmon and of Mrs. Ames at NY and US, dated 1875, are authentic but perhaps no more than topotypi.—*Tragacantha Webberi* (Gray) O. Kze., Rev. Gen. 949. 1891. *Xylophacos Webberi* (Gray) Rydb. in Bull. Torr. Club 52: 151. 1925.

The Webber milk-vetch is a rather coarse astragalus, one which might easily be passed off as commonplace until the finer points of its structure are appreciated. It is one of very few members of the genus native to the west slope of the northern Sierra Nevada, and since the others have papery inflated fruits borne on a long stipe, there should be no difficulty in identifying mature specimens. However, on account of the toughness of the woody root and the often unwieldy length of the stems, the basal parts bearing the characteristic stipule-sheaths are seldom collected; and since the fruits come to maturity slowly, after all flowers are past, the herbarium material is mostly incomplete. A feature to look for in poor specimens of *A. Webberi* is the fine, appressed, lustrous vesture of the leaves, which is not very noticeable in the living plant but imparts to the dried foliage an instantly recognizable satiny sheen.

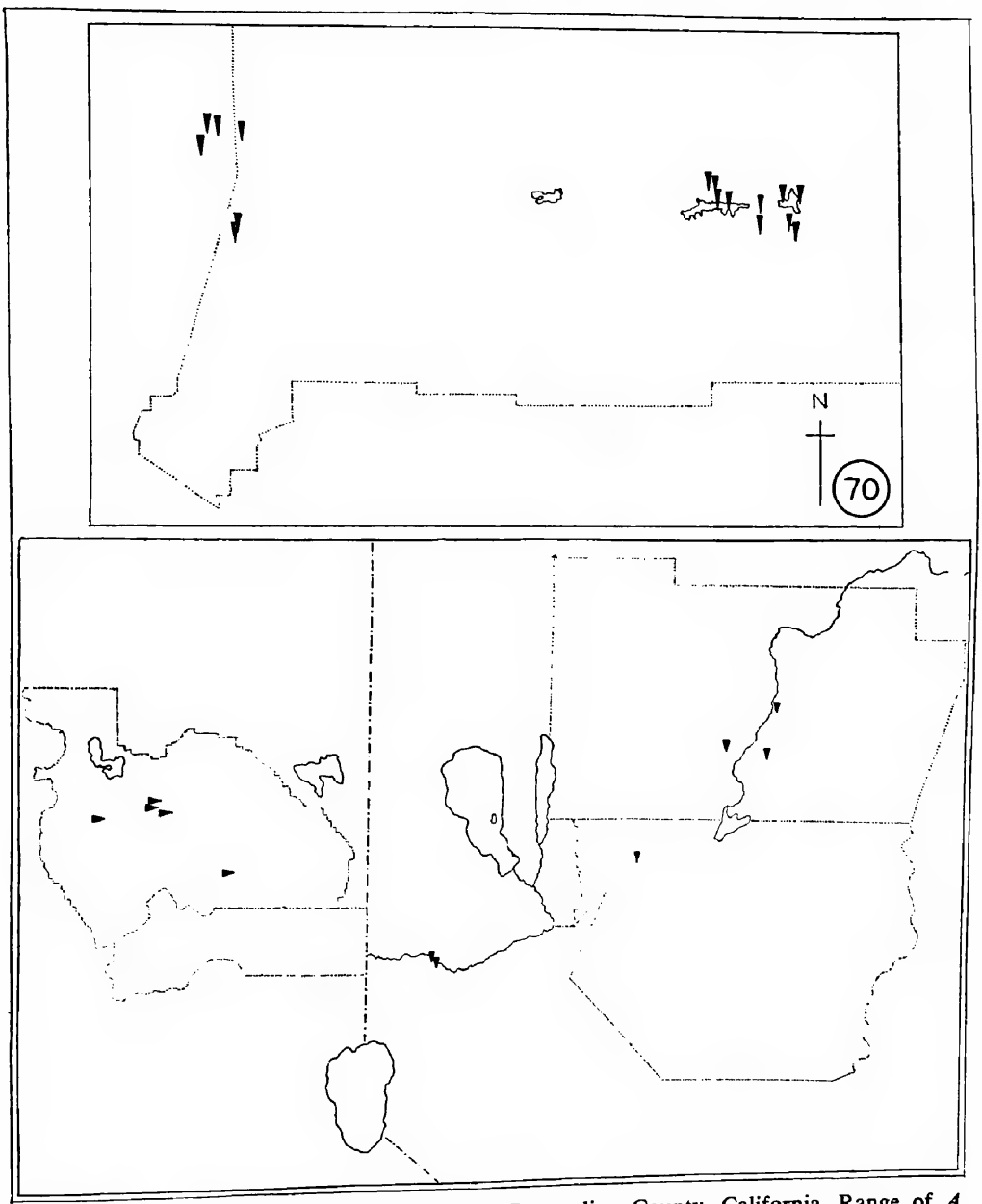
The accompanying map shows only those stations for *A. Webberi* that have been recorded and identified precisely, all in Plumas County. Some early collections of the species were labeled Sierra County or Sierra Valley, but both terms (the second especially) were used with

considerable vagueness by Lemmon and his associates in the northern Sierra settlements. There is no modern collection from east of the Sierra crest.

XLVII (ii). Subsectio Bicristati

Characters as given in the key.—Sp. 1, of the San Bernardino and San Gabriel Mountains, southern California.

Astragalus sect. Bicristati, sect. nov., ob stipulas imas inter se concretas et legumina persistentia crassa obcompressa subunilocularia sect. *Conjunctis* ut videtur affines, sed caulibus diffusis evolutis, pedunculisque axi caulino primario multo brevioribus, et praesertim collo ra-



Map No. 70. Top, southwestern corner of San Bernardino County, California. Range of *A. bicristatus*. Bottom, parts of western Nevada and adjoining California. Range of ◗ *A. Webberi*; and of ◀▶ *A. porrectus*.

dicis subterraneo, habitu toto dissimiles.—Sp. typica: *A. bicristatus* Gray.—Subsectio *Bicristati* (genuini) legumine pendulo stipitato per stipitem nec per rostrum dehiscenti statim diagnoscitur.

175. Astragalus bicristatus

Low but vigorous, rarely quite slender, strigulose nearly throughout with fine, straight, appressed or subappressed hairs up to (0.35) 0.4–0.6 (0.7) mm. long, the herbage green or cinereous, the leaflets varying from equally pubescent on both sides to densely cinereous or quite glabrous above, the inflorescence ± black-hairy; *stems* several or numerous, decumbent and assurgent, 2–4 (4.5) dm. long, commonly branching near the purplish, leafless, shortly subterranean base, the stronger branches bearing spurs or branchlets at 1–3 nodes preceding the first peduncle, more rarely simple; *stipules* 1.5–4 mm. long, dimorphic, the lowest early becoming papery-scarious, the very lowest 1–3 pairs amplexicaul and connate into a bidentate sheath or low collar, the rest ovate or deltoid-acuminate, cauline, the herbaceous blades deflexed; *leaves* 3–11 (13.5) cm. long, the lower shortly petioled, the upper subsessile, with (11) 13–21 (23) opposite or scattered, linear, linear-elliptic, or narrowly oblong, more rarely oblong-elliptic or oblanceolate, mostly obtuse or retuse, sometimes subacute, folded, involute, or rarely flat leaflets (2) 4–25 (27) mm. long, the terminal one usually jointed like the rest, sometimes (in some upper leaves) continuous with the rachis; *peduncles* rather stout, 5–12 (15) cm. long, usually longer than the leaf, incurved-ascending; racemes loosely or (at very early anthesis) closely 5–15 (20)-flowered, the flowers ascending, the axis becoming 1.5–6 (9) cm. long in fruit; *bracts* membranous, triangular-ovate, 1.5–2.5 mm. long; *pedicels* at anthesis straight, ascending, 0.8–1.7 mm. long, in fruit thickened, arched outward, (1) 1.4–2.5 mm. long; *bracteoles* 2, minute, rarely 0; *calyx* 8.1–10.1 mm. long, loosely strigulose with black or mixed black and white hairs, the oblique disc 1.3–2 mm. deep, the submembranous, pallid, deeply campanulate tube 5.8–7.6 mm. long, 3.8–4.7 mm. in diameter, the subulate teeth 1.8–3.3 mm. long, the ventral pair often shortest and broadest, the orifice oblique; *petals* greenish-white, drying ochroleucous, immaculate; *banner* recurved through 45–50° (further in withering), rhombic-elliptic or -lanceolate, cuneate at base, broadest below the middle, the blade tapering upward, notched at the narrow apex; *wings* 13–16 mm. long, the claws 6.5–7.8 mm., the narrowly lance- or rarely oblance-oblong, obtuse or erose-emarginate blades 7.2–9.7 mm. long, (2) 2.3–3 mm. wide; *keel* 12–13 mm. long, the claws 6.5–7.6 mm., the half-obovate blades 5.4–7 mm. long, 2.9–3.7 mm. wide, abruptly incurved through 90–95° to the sharply deltoid apex; *anthers* 0.6–0.85 (0.95) mm. long; *pod* pendulous, stipitate, the stout, downwardly arched stipe (6) 8–12 mm. long, the body obliquely oblong- or clavate-ellipsoid, 2–4 (4.3) cm. long, 5–8.5 (9) mm. in diameter, either cuneate at base or (more often) acuminately tapering from above the middle into the stipe, cuneately contracted distally into a triangular-acuminate, rarely long-acuminate, stiffly cuspidate, laterally compressed beak, the whole either gently lunate-incurved its whole length, or straight below and then abruptly hamate, or evenly arched through ½-circle, or exceptionally coiled into a ring, the body fleshy and subterete or a trifle obcompressed when first formed, becoming more strongly dorsiventrally compressed in ripening (and the more so the more incurved), at length bicarinate by the salient sutures, the lateral angles transversely dilated and obtuse-angled, the thick, smooth, green, glabrous valves becoming brownish, stiffly leathery or subligneous, coarsely rugulose-reticulate and wrinkled lengthwise distally, not inflexed; *dehiscence* primarily through the stipe and upward ⅓ way through both sutures, also tardily apical, through the beak; *ovules* 26–33; *seeds* brown, purple-speckled, smooth, dull or sublustrous, 2.8–3.8 mm. long.—Collections: 25 (i);

representative: *Parish 3000* (NY, WS); *Johnston 2039* (POM, US), *6607* (POM); *Jones* (from Baldwin Lake) *in 1927* (CAS, POM); *Munz 10,627* (POM).

Rocky ridges, stony sagebrush flats, lake shores, canyon benches, and openings in pine forest, 5850–8000 (reportedly 9000) feet, local but forming colonies in the transverse ranges of southern California, in particular about the east end of the San Gabriel Range (West and Prairie Forks of San Gabriel River to Swartout Valley) and northeast end of the San Bernardino Mountains (Bear and Holcomb Valleys and the north slope of Sugarloaf Mountain), Los Angeles and western San Bernardino Counties.—Map No. 70.—May to August.

ASTRAGALUS BICRISTATUS (double-crested, of the prominently two-keeled pod) Gray in Proc. Amer. Acad. 19: 75. 1883.—"San Bernardino Mountains, S. E. California, in a canon on the Mohave side, May, 1882, in flower, and in Holcomb Valley, August, flower and fruit, *S. B. & W. F. Parish.*"—Cotypi *(Parish & Parish 1277 & 1277a)*, GH! isotypi *(No. 1277)*, DS, K, MO, PH, US!—*Homalobus bicristatus* (Gray) Rydb. in Bull. Torr. Club 51: 19. 1924.

Astragalus bicristatus var. *tetrapteroides* (resembling *A. tetrapterus*) Jones, Contrib. West. Bot. 10: 58. 1902.—"Bear Valley, San Bernardino Mountains, California, Jones, August, 1900." —Holotypus, dated July 19, 1900, *Jones 6235*, POM!

The most distinctive feature and chief ornament of the two-keeled milk-vetch, *A. bicristatus*, is its massive, pendulous, long-stipitate pod. The stipe turns down out of the calyx in a gentle arc and the body, which is commonly broadest a little above the middle and tapers downward into the stipe, is variably incurved, forming in profile a crescentic, abruptly hooked, or more rarely an annular figure. The body of the pod is subterete when first formed, although the cavity is already somewhat transversely dilated, and the characteristic bluntly quadrangular cross-section is achieved only as the fleshy tissues collapse in drying and reveal the salient sutural keels. The foliage of *A. bicristatus* varies in amplitude, the leaflets fluctuating between truly linear and oblong-elliptic; but the leaflets are disposed so distantly along the rachis that even the broadest type presents a sparsely leafy aspect. A minor variant with leaflets canescently strigulose on the upper face and greenish beneath occurs with the commoner thinly hairy type. The var. *tetrapteroides* was based on typical material of the species examined in the living state.

The two small areas of dispersal to which *A. bicristatus* is apparently restricted hardly exceed ten miles in diameter and lie about thirty-five miles apart. In both the species is associated with *A. Douglasii* and with a locally endemic variety of *A. lentiginosus*. These have much smaller flowers than *A. bicristatus* and sessile, bladdery pods of papery texture.

XLVIII. Sectio PORRECTI

Caulescent perennials, with superficial or aerial caudex; *vesture* basifixed, scanty; *stipules* dimorphic, the lowest connate, the upper mostly free; *leaves* imparipinnate, with 9–13 leaflets; *flowers* remotely racemose, ascending, small, the banner ± 8–11 mm. long; *pedicels* persistent; *calyx-tube* campanulate; *petals* white, regularly graduated, the banner recurved through 60–80°, the keel-tip obtuse; *pod* erect or incurved-ascending, stipitate, continuous with the receptacle, the body lunately oblong-ellipsoid, laterally compressed, carinate by both sutures, unilocular, the valves leathery; *dehiscence* apical, tardy, on the raceme; *ovules* 7–10.—Sp. 1, xerophyte, of desert sinks in westcentral Nevada.

ASTRAGALUS sect. PORRECTI (Rydb.), comb. nov., based on *Homalobus* sect. *Porrecti* Rydb. in Bull. Torr. Club 51: 19. 1924.—Sp. typica (unica): *H. porrectus* (Wats.) Rydb. = *A. porrectus* Wats.

In the context of its genus, *A. porrectus* is an isolated monotype distinguished by an unique set of morphological characters combined with a pronounced individual facies. Its affinities are doubtful, and it is introduced at this place for lack of one more obviously appropriate. The connate stipules and ascending pod are suggestive of a distant connection with sect. *Conjuncti*, but the small, white flowers, shallowly campanulate calyx-tube, and laterally flattened pod are at variance with that group, not to mention the dissimilarities in habit of

growth and general aspect. The pod of *A. porrectus* has much in common with that of *A. Tweedyi,* but differences in position of the caudex, structure of the stipules, form of the flowers, and number of ovules discredit the idea of any truly close relationship between the species. Probably *A. porrectus* is highly modified, representing the terminus of a distinct evolutionary line of emmenoloboid astragali.

176 Astragalus porrectus

Stiff, sparsely leafy, with a woody taproot and loosely forking, at length indurated caudex, thinly strigulose with straight, somewhat flattened, truly appressed hairs up to 0.3–0.5 mm. long, the stems glabrous or nearly so below the middle, the herbage green, the leaflets glabrous on both sides, sparsely ciliate; *stems* several, erect and ascending in bushy clumps, 2.5–4 dm. long, leafless at base, branched or spurred at 1–4 nodes preceding the first peduncle, flexuous or zigzag distally; *stipules* scarious or early becoming so, 2–9 mm. long, the lowest of the main stems and of the more slender branches connate into an amplexicaul sheath (sometimes ruptured in age), the median and upper ones deltoid or deltoid-acuminate, semiamplexicaul, their margins beset with a few minute processes; *leaves* shortly petioled or the upper ones subsessile, 3.5–11 cm. long, with 9–13 rather distant, broadly obovate-cuneate or -flabellate, very obtuse to shallowly retuse, flat, thick-textured leaflets 7–15 (18) mm. long, the midrib prominent beneath and giving rise to 1–3 pairs of semi-immersed lateral veins; *peduncles* stiffly erect, 3.5–15 cm. long, the lower ones far longer than the leaf, the early inflorescences often overtopping the more shortly pedunculate later ones; *racemes* very loosely or remotely (7) 12–33-flowered, the axis 4–20 (28) cm. long in fruit; *bracts* membranous, linear-lanceolate or subulate, 1–3.4 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 0.5–2 mm., in fruit little thickened, (0.9) 1.2–2 mm. long; *bracteoles* 0; *calyx* 4.7–5.5 mm. long, black-strigulose, the subsymmetric disc 0.7–0.8 mm. deep, the tube 3–3.5 mm. long, 2.2–3 mm. in diameter, the narrowly subulate teeth 1.7–2 mm. long, the ventral pair often shortest, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* white, drying ochroleucous; *banner* 8–11 mm. long, the cuneate claw expanded into an ovate or suborbicular, emarginate blade 5–7 mm. wide; *wings* 7.8–9 mm. long, the claws 3–3.5 mm., the broadly oblanceolate, obtuse or obscurely emarginate, nearly straight or gently incurved blades 5.3–6.9 mm. long, 2–2.6 mm. wide; *keel* 6.8–7.7 mm. long, the claws 3.2–3.5 mm., the half-obovate blades 4–4.7 mm. long, 2.2–2.5 mm. wide, incurved through 95° into the bluntly deltoid apex; *anthers* 0.4–0.6 mm. long; *pod* incurved-ascending, stipitate, the straight or slightly incurved stipe spreading from the raceme at a wide angle, (2.5) 3–5 mm. long, the body lunately oblong-ellipsoid, 8-15 mm. long, 3–5 mm. in diameter, incurved through ± ¼-circle, cuneate at base, abruptly cuspidate at apex, laterally compressed, bicarinate by the salient, riblike sutures, the lateral faces concave along the ventral suture and convex along the dorsal one, the moderately fleshy, glabrous, green or sometimes purple-tinged or -mottled valves becoming leathery, stramineous sometimes suffused with purplish-brown, transversly reticulate, not inflexed; seeds brown, smooth, 2.5–3 mm. long.—Collections: 6 (ii); representative: *Eastwood & Howell 7* (CAS), *125* (CAS, NY); *Ripley & Barneby 5646* (CAS, NY, RSA), *5654* (CAS, GH, RSA).

Hot gravelly washes and outwash fans in the foothills of desert mountains, in volcanic sand or rock-debris, 4300–5000 feet, rare and local, known only from the lower Humboldt and Truckee Valleys in Churchill, Pershing and southern Washoe Counties, Nevada.—Map. No. 70.—May and June, the fruit long persisting.

Astragalus porrectus (stretched out, apparently from the elongate raceme) Wats., Bot. King 75. 1871.—"Trinity Mountains, Nevada; 5000 feet altitude; May ([Watson] 284)."—

Holotypus, collected in 1868, US! isotypus, GH!—*Tragacantha porrecta* (Wats.) O. Kze., Rev. Gen. 947. 1891. *Homalobus porrectus* (Wats.) Rydb. in Bull. Torr. Club 51: 19. 1924.

A rather tall, stiffly branching but nonetheless airily graceful plant, *A. porrectus* is readily recognized by its scarious sheathing lower stipules, by its few, almost glabrous leaflets of broad outline and leathery texture loosely disposed along a stiff, tapering rachis, and by its open racemes of small, white flowers which give rise to stipitate, incurved, laterally compressed pods carinate along both edges by salient sutures. The species has been collected seldom, and in the two stations known to me only a few plants were found. It is restricted in range to the bed of Lake Lahontan, the body of water that covered a large part of westcentral Nevada at intervals during the Pleistocene. It seems hardly credible that *A. porrectus*, so greatly isolated taxonomically, could have evolved in situ in the relatively short period of time during which its habitat has been available to continuous colonization by higher plants. Possibly it is a relic of a formerly more widely dispersed flora which, having survived (by adaptive mutation) the vicissitudes of climatic change, has found refuge in the non-competitive, however austere environment of a desert sink. It might appropriately be called the Lahontan milk-vetch.

XLIX. Sectio AMPULLARII

Caulescent perennials, with deeply buried root-crown; *vesture* basifixed, scanty; *stipules*, except some upper ones, connate; *leaves* imparipinnate, with ± 11–17 leaflets; *flowers* racemose, ascending, of moderate size, the banner 13.5–20 mm. long; *pedicels* thickened, persistent; *calyx-tube* campanulate; *petals* regularly graduated, ochroleucous or purplish, the banner recurved through ± 30°, the keel-tip obtuse; *pod* erect, long-stipitate, the oblong-ovoid or subglobose body inflated, uni- or subunilocular, the valves stiffly papery; *dehiscence* apical, on the raceme; *ovules* 17–25.—Sp. 1, of stiff gumbo-clay knolls, moist in spring but dry in summer, very local in southwestern Utah.

ASTRAGALUS sect. AMPULLARII, sect. nov., a *Preussianis* (inter quos species singula hucusque enumerata) stipulis connatis, radicisque collo profunde sepulto absimiles. Ab *Ampullariis* inodoris *Preussiani* selenium spirantes foetidi ulterius differunt.—Sp. unica: *A. ampullarius* Wats.

Another peculiar monotype of controversial affinity, *A. ampullarius* has been associated traditionally with *A. Preussii* and its near kindred, being aligned by Jones (1923, p. 154, Pl. 33) in his sect. *Preussiani ("Preussii")* and by Rydberg in the synonymous but more narrowly defined section of *Phaca* subgen. *Dermatocystis*. Until a few years ago the species was represented in herbaria by the type-collection alone, an inadequate basis for evaluation of its systematic position. Now better known, *A. ampullarius* is found to differ fundamentally from all *Preussiani* in its deeply buried root-crown and connate stipules. Furthermore the fresh herbage is free of the disagreeable odor of selenium, which is so marked a feature of *A. Preussii*. The point requires confirmation by chemical analysis. It seems probable, however, that *A. ampullarius* is not a selenium-converting species, even though it is sometimes associated with the definitely seleniferous *A. flavus* var. *confertiflorus* and with *Stanleya*, a prime indicator of selenium-rich soils. In *Astragalus* the physiological adaptation to selenium has proved to coincide neatly and consistently with differential characters useful in the taxonomy of the genus and confirms the naturalness of groups already defined in morphological terms. If the *Preussiani* can be discounted as close relatives of *A. ampullarius*, the problem of tracing its real affinities remains unsolved, and the species is introduced at this place on purely technical grounds. A possible connection with sect. *Reventi-arrecti* is suggested by the close resemblance in the leaves, pubescence, and flowers to *A. eremiticus*, especially if forms of the latter found near at hand in southwestern Utah are picked out for comparison. The pod of *A. eremiticus* is similar in orientation and in its long stipe, but the body is scarcely inflated, obcompressed-triquetrous, and semibilocular. However the pod of *A. ampullarius*, although as a rule truly unilocular, is sometimes narrowly septiferous in the lower half; and a transition from a little inflated pod to one greatly swollen and, in consequence, not sulcate dorsally may be thought of as a comparatively easy evolutionary step. Yet obstacles to any such hypothesis of relationship are the buried root-crown and sheathing stipules which have no counterpart in sect. *Reventi-arrecti*. There is no alternative except to leave open the question of the affinity of *A. ampullarius*. In any case, its title to a monotypic section is unlikely to be challenged.

177. Astragalus ampullarius

Low, slender, strigulose with flattened, tapering, scalelike hairs up to 0.35 mm. long, the lower emersed internodes and petioles commonly canescent, the herbage green, the leaflets either thinly pubescent or glabrous beneath, glabrous and brighter green above, ciliate; *stems* solitary or few together, arising directly from the root-crown, subterranean for a space of 3.5–14 cm., at emergence stouter, bearing 1–2 short branches or spurs at the first, usually approximate, aerial nodes, thereafter simple, erect or ascending, above ground 2.5–7.5 cm. long; *stipules* membranous, pallid, 2.5–6 mm. long, those at the buried nodes connate into a cylindric sheath, the rest amplexicaul and shortly connate, the first above ground ovate, obtuse, the rest drawn out into deltoid or lanceolate free blades, or some upper ones only semiamplexicaul and free; *leaves* 3–10 (14) cm. long, the petioles commonly widely divaricate, with (7) 11–15 (19) obovate- or ovate-cuneate, rarely elliptic, obtuse or retuse, flat leaflets 6–15 mm. long; *peduncles* 1 or 2, the upper one appearing terminal, strictly erect, (1) 2–8 (11.5) cm. long; *racemes* loosely 6–20-flowered, the axis 1.2–13 cm. long in fruit; *bracts* membranous, lanceolate, 1.5–3 mm. long; *pedicels* at anthesis 1–1.7 mm. long, in fruit thickened, straight, ascending, 1.8–3 mm. long; *bracteoles* 2; *calyx* 4.8–7 mm. long, thinly black-strigulose, the oblique disc 0.7–1 mm. deep, the membranous tube 4.2–6 mm. long, 2.5–3.5 mm. in diameter, the subulate dorsal tooth 0.5–1 mm. long, the rest either similar, or shorter and deltoid, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* all ochroleucous, or purple with white wing-tips and pale, striate eye in the banner, if purple drying violet; *banner* elliptic or rhombic-elliptic, 13.5–20 mm. long, 5.6–6.8 mm. wide; *wings* 10.6–18.3 mm. long, the claws 4.4–7.2 mm., the lance-oblong or oblong-oblanceolate blades 7.4–12.5 mm. long, 2.2–2.5 mm. wide; *keel* 9–12.2 mm. long, the claws 3.3–7 mm., the lunately half-obovate blades gently incurved through 80–90° to the rounded apex; *anthers* 0.55–0.65 mm. long; *pod* erect, stipitate, the slender, nearly straight stipe 9–19 mm. long, the body broadly ovoid, oblong-ovoid, or subglobose, strongly inflated, 1.2–2 cm. long, 8–11 mm. in diameter, nearly symmetric but commonly a trifle more convex on the dorsal side, truncate at base, abruptly contracted distally into a short, compressed-conic, cuspidate beak, terete or nearly so, esulcate, the thin, green, purple-dotted, glabrous valves becoming purplish-stramineous, papery, either not inflexed or inflexed near the base as a rudimentary septum up to 0.3 mm. wide, the funicular flange narrow, ± 0.5 mm. wide; *seeds* light brown, smooth but dull, 2–2.2 mm. long.—Collections: 7 (iii); representative: *Eastwood & Howell 9149* (CAS, RSA), *9299* (CAS, RSA, US); *Ripley & Barneby 4307, 4802* (CAS, RSA).

Barren gumbo-clay knolls derived from disintegrated white or red sandstones, associated with *Eriogonum subreniforme* Wats., *Phacelia cephalotes* Gray, or both, 3200–5400 feet, rare and local, known only from three (possibly four) narrowly restricted stations along the south base of the Zion Escarpment (Kanab; south of Orderville; east of Washington) in western Kane and Washington Counties, Utah.—Map No. 71.—Late April to June.

Astragalus ampullarius (flask-shaped, of the pod) Wats. in Amer. Nat. 7: 300. 1873. —"Kanab, Southern Utah, (Mrs. E. P. Thompson)."—Holotypus, GH! isotypus, dated 1872, US!—*Tragacantha ampullaria* (Wats.) O. Kze., Rev. Gen. 943. 1891. *Phaca ampullaria* (Wats.) Rydb. in Bull. Torr. Club **40**: 47. 1913.

The singular gumbo milk-vetch, *A. ampullarius,* occurs in small quantity in a specialized environment and is one of the truly rare astragali. Nearly seventy years elapsed between the original collection at Kanab and rediscovery of the species, in 1941, by Alice Eastwood and John Thomas Howell at the type-locality and in a new station in the Virgin Valley some fifty

miles westward. In the following summer Ripley & Barneby established a third locality about twenty-five miles northwest of Kanab. These remain the only stations certainly known. A browsed fragment collected by Ripley on clay mounds near Cedar City in Iron County was thought at the time to be, in all probability, *A. ampullarius;* but the specimen was lost. The species is to be sought in the foothills of the Kolob Plateau.

The gumbo knolls, to which *A. ampullarius* is rigidly confined, are a remarkable geological feature of the sandstone butte country of the Colorado Basin. Often brightly colored in tones of purple, violet, or rosy-lavender, sometimes with alternating belts of arsenical green or sulfurous yellow, they appear from a distance barren of vegetation but play host to some of the most interestingly modified and specialized plants of the region, among them several species of *Phacelia* and *Eriogonum*. Howell (in Leafl. West. Bot. 3: 137–8) has described these mounds as representing the comminuted remnants left behind as the vertical front of a sandstone cliff retreats before the stresses of erosion. They are composed of a fine-grained clay, often mixed with rock fragments, but highly retentive of moisture, which turns after spring rains to a stiff putty-like ooze into which the hooves of wandering cattle sink, leaving prints a foot or more deep. As the surface dries out slowly, the crust breaks up into polygonal plates of the form seen on the beds of desiccating pools, but at a depth of a few inches some palpable moisture is imprisoned throughout the summer. The root of the gumbo milk-vetch penetrates deeply into this apparently inhospitable medium. Its crown, bearing the annual points of renewal, is buried at a depth of up to a decimeter, and only a few centimeters of the stems appear above the surface. The leaves, crowded on the stem, are arranged in what I might describe as a loose rosette pressed to the ground; the solitary or sometimes two peduncles rise vertically from near the stem's apex. The pod of *A. ampullarius* possesses a delicate beauty because of the length and slenderness of the stipe, which bears aloft the proportionately large and plumply swollen, purple-speckled body.

In the drainage of Kanab Creek, near Kanab and Orderville, the flowers of *A. ampullarius* are bicolored, with violet-purple banner and obtuse, white wing-tips, and the calyx-teeth are subulate and of nearly equal length. Near Washington in the Virgin Valley, the petals are ochroleucous, with concolorous, distinctly emarginate wing-tips, and the paired calyx-teeth are shorter and deltoid. The species is confined to so narrow an ecological niche that each population becomes, in effect, an insular endemic as securely quarantined against its nearest neighbor as if separated by leagues of sea. In such circumstances small genetic differences and small mutations may well become established and perpetuated in different colonies.

L. Sectio PACHYPHYLLUS

Robust, caulescent perennials, with taproot and superficial or shallowly buried root-crown, glabrous below the inflorescence, the sparse vesture basifixed; *stipules* semi- or almost fully amplexicaul, free; *leaves* unifoliolate, the large, leathery, suborbicular blades jointed to a very short rachis, appearing sessile; *racemes* short, the few, large flowers ascending, the banner 17–23.5 mm. long; *pedicels* ascending, clavate-thickened, persistent; *calyx-tube* cylindric; *petals* greenish-yellow or purplish, graduated, little incurved, the keel-tip obtuse; *pod* erect, persistent, stipitate, the large body ovoid-ellipsoid, inflated but scarcely bladdery, the leathery or stiffly papery valves inflexed as a very narrow partial septum; *dehiscence* apical, through the gaping beak; *ovules* 46–62.—Sp. 1, xerophyte, of the Colorado Basin and lower Sevier Valley, central Utah to western Colorado.

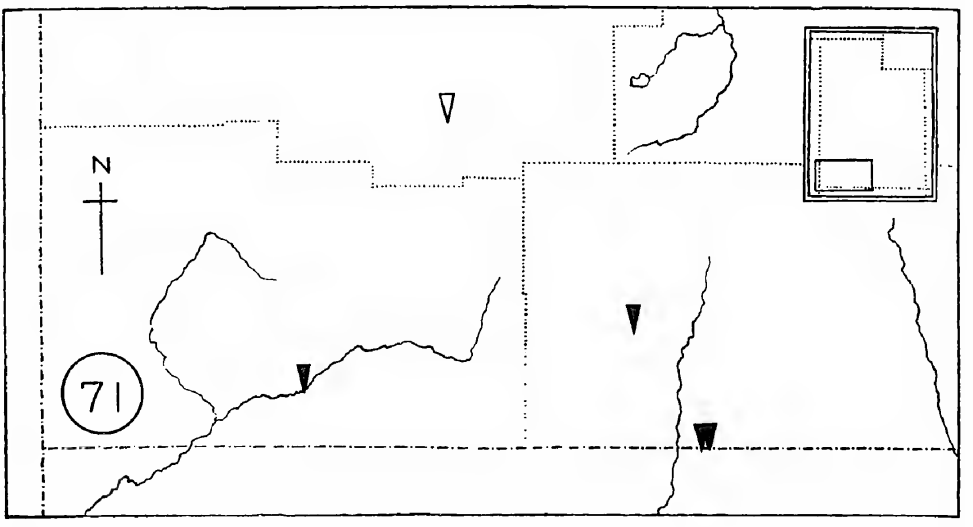
Astragalus sect. Pachyphyllus Jones in Zoë 2: 239. 1891. (*"Pachyphylla"*, a typographical error, acc. Jones in Proc. Calif. Acad. Sci. II, 5: 657. 1895).—Sp. typica: *A. asclepiadoides* Jones.

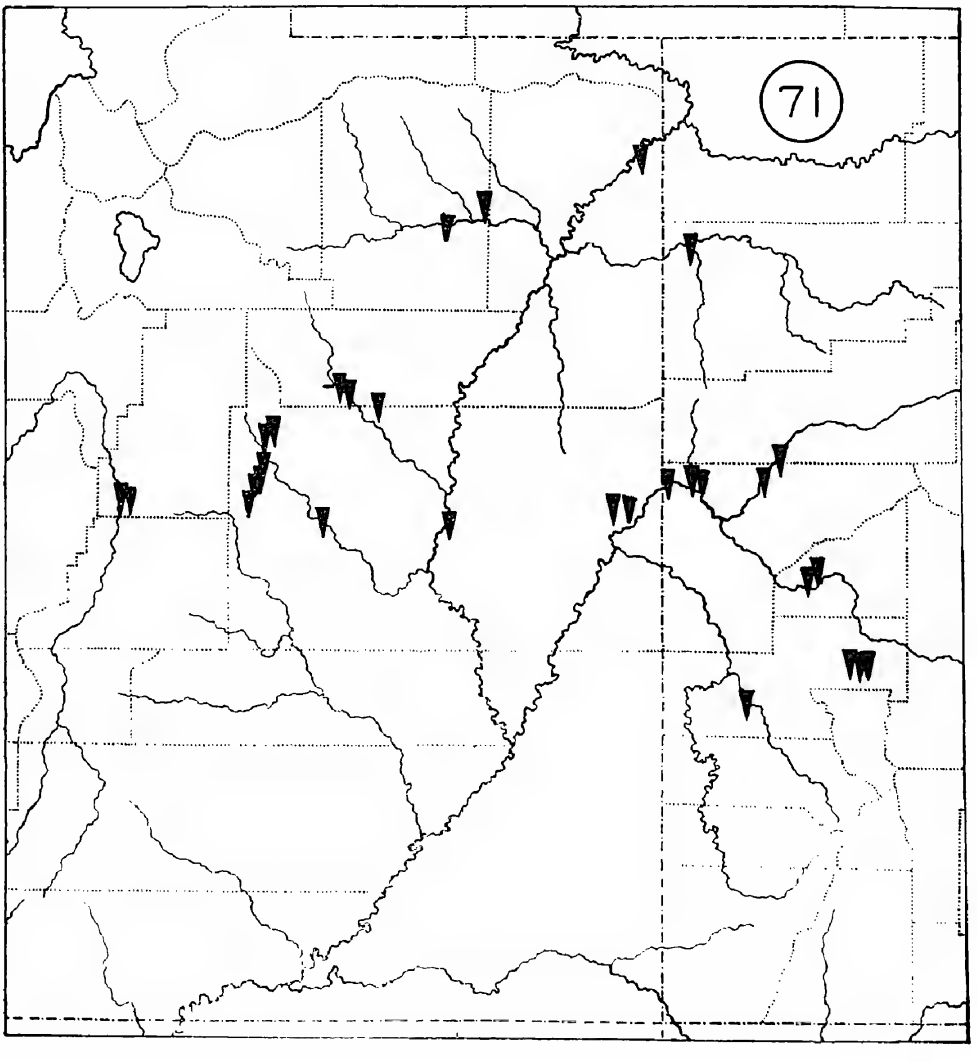
Astragalus sect. *Asclepiadodes* Sheld. in Minn. Bot. Stud. 1: 159. 1894.—Sp. typica: *A. asclepiadoides* Jones.

Jonesiella Rydb. in Bull. Torr. Club 32: 661. 1905.—Generitypus: *J. asclepiadoides* (Jones) Rydb. = *A. asclepiadoides* Jones.—*Astragalus* subgen. *Jonesiella* (Rydb.) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Utah & Nev.): 318. 1925.

178. Astragalus asclepiadoides

Stout, caulescent herbs of singular appearance, glabrous except for the bracts, pedicels, and calyx, the large, simple, subsessile leaf-blades leathery and


N
71


71

glaucous; *stems* solitary or more often several or numerous, erect and ascending in clumps from a thick, pluricipital root-crown at or just below soil-level, 0.7–3.5 (4) dm. long, simple or nearly so, leafless at the lower nodes, but the base often clothed in a thatch of imbricated stipules; *stipules* membranous, pale, or early becoming so, ovate or deltoid, 2–15 mm. long, shortly adnate to the margins of the subobsolete petiole, decurrent on the stem, amplexicaul around ⅓ to nearly the whole stem's circumference, free; *leaves* crowded, loosely imbricated, reduced to a subsessile, broadly ovate to suborbicular, obtuse or shallowly retuse and mucronulate leaflet 1.5–4.5 cm. long, prominently pinnate-nerved beneath; *peduncles* stout, erect, 1–4.5 cm. long; *racemes* rather closely 5–12-flowered, the flowers narrowly ascending, usually only 1–3 of the lowest maturing fruit, the axis little elongating, 0.4–2.5 cm. long in fruit; *bracts* membranous, ovate or ovate-acuminate, 1–3 (5) mm. long; *pedicels* ascending, at anthesis 1–2 mm. long, in fruit greatly thickened, 2–4 mm. long; *bracteoles* commonly 2, at or below the base of the calyx; *calyx* 10.5–15 mm. long, thinly strigulose with short, black hairs, the obliquely obconic disc 1.3–2.5 (3) mm. deep, the cylindric, membranous and sometimes turgid tube 8.8–11.4 mm. long, 2.8–4.6 mm. in diameter, the orifice oblique, the subulate teeth 1.3–3.5 mm. long, the whole becoming papery, marcescent unruptured; *petals* greenish-yellow with pale wing-tips and luridly purple-tipped keel, or all dull purple with pale or white wing-tips; *banner* gently recurved through ± 30°, broadly oblanceolate or somewhat rhombically angled in the distal ⅓, notched, 17–23.5 mm. long, 6.8–10 mm. wide; *wings* 16.8–21 mm. long, the claws 10–12 mm., the narrowly oblong or lance-oblong, obtuse, nearly straight blades 7.3–10.4 mm. long, 1.9–3.1 mm. wide; *keel* 14.2–18.5 mm. long, the claws 9–12 mm., the lunate blades 5.7–8.2 mm. long, 2.7–3.3 mm. wide, gently incurved through 80–100° to the rounded apex; *anthers* 0.6–0.9 (1) mm. long; *pod* erect, stipitate, the stout, clavate stipe 1–2.1 cm. long, the body broadly and subsymmetrically ovoid or ovoid-ellipsoid, inflated but scarcely bladdery, (2) 2.5–3.5 cm. long, 1.1–1.6 cm. in diameter, subtruncate or rarely cuneately contracted at base, abruptly contracted distally into a conic and cuspidate, slightly compressed beak, otherwise subterete but shallowly and openly sulcate ventrally, the somewhat fleshy, pale green but purple-speckled, glabrous valves becoming leathery or stiffly papery, stramineous, faintly reticulate, inflexed as a very narrow septum 0.5–1 mm. wide, the ventral suture also inwardly produced as a flange 0.7–1.2 mm. wide; *seeds* pale brown, smooth, dull, 2.2–3 mm. long.—Collections: 30 (viii); representative: *Jones 5455* (MO, NY, POM, WIS); *W. A. Weber 3733* (CAS, TEX, WS), *7482* (CAS, SMU); *Ripley & Barneby 4703* (CAS, NY, RSA); *Barneby 12,690* (CAS, NY, RSA).

Adobe clay flats, gullied knolls, and gulches in barren clay or cobblestone-clay hills, bluffs, and badlands, commonly associated with *Atriplex* species in saline soils derived from weathered shales and standstones, 4100–6000 feet, not uncommon and locally plentiful in the basins of the Green and Grand Rivers in eastern Utah and western Colorado, from the Uinta Basin to the San Rafael Swell, east around the foot of Tavaputs Escarpment to the lower Grand and Gunnison Rivers; also somewhat isolated in the Sevier Valley near Gunnison, Sanpete County, Utah. —Map. No. 71.—May and June, the fruit long persisting.

ASTRAGALUS ASCLEPIADOIDES (resembling, in the leathery, glaucous foliage, *Asclepias cryptoceras* Wats.) Jones in Zoë 2: 238. 1891.—"... on sand-bars along the Price River, in Eastern Utah, elvation 5,000 feet ... first collected by me ... in September, 1888, and also at

Map No. 71. Top, southwestern corner of Utah, showing the Virgin-Sevier-Paria divide. Range of *A. ampullarius*. Bottom, the Colorado Basin. Range of *A. asclepiadoides*.

Green River, Utah . . . on June 21, 1889."—Holotypus, collected June 21, 1889 at Cisco, Grand County, POM! paratypus, from Price, in 1888, POM!—*Jonesiella asclepiadoides* (Jones) Rydb. in Bull. Torr. Club 32: 661. 1905.

The milkweed milk-vetch, *A. asclepiadoides,* is one of the pre-eminently singular monotypes in the genus. Its most remarkable feature is the reduction of the leaf to a simple, leathery blade of broadly ovate or circular outline, which appears sessile on the stem but is in reality jointed to a subobsolete petiole and evidently represents the terminal leaflet of the primordial imparipinnate leaf. A similar modification has occurred in the Armeno-Caucasian *A. Candolleanus* Bss., although in this instance the petiole remains fully developed; and the closely related *A. latifolius* Lamk., with its three- or at best few-foliolate leaves shows an intermediate stage of evolution from the ordinary pinnate leaf of sect. *Proselius* Bge. In *A. asclepiadoides* no such intermediate species has survived to point to any near relatives in the genus, and its affinities remain very doubtful. Jones assumed a relationship to the rare and remarkable *A. sabulosus,* which has, indeed, uncommonly few and large leaflets, and inhabits, moreover, a similar environment; but this differs so greatly in its nodding, sessile pod that the assumption is not justified. Furthermore, *A. sabulosus* is seleniferous, whereas *A. asclepiadoides,* even though native to soils often rich in selenium, absorbs only insignificant amounts of the element and lacks the characteristic odor of the selenium-converter. The differences in physiology, together with the morphological disparities, provide a strong case against combining the *Pattersoniani* and *Sabulosi* with *A. asclepiadoides* into *Jonesiella* Rydb. or the even more inclusive sect. *Preussii* Jones. An imaginary plant combining the flowers and fruits of *A. asclepiadoides* with leaves of a common pinnate type would be most nearly suggestive of sect. *Reventi-arrecti,* but no particular species of that group can be singled out as related to the milk-weed milk-vetch in any near sense. An affinity in the same direction, and equally remote, has been suggested for the equally curious monotype *A. ampullarius.* It seems possible that both have arisen from progenitors of the *A. eremiticus* type. The deeply buried root-crown and connate stipules of *A. ampullarius* exclude the species readily from sect. *Pachyphyllus,* although the pod is similar to that of *A. asclepiadoides* in most technical details.

The milkweed milk-vetch is comparatively common on the upper Price and San Rafael Rivers, and again along the lower Grand River and principal tributaries, but it has seldom been collected on the intervening deserts of the lower Green River in Utah and is rare on the floor of the Uinta Basin. The variation in flower-color, from a greenish-yellow to dull, lurid purple, usually with contrasting pallid or whitish wing-tips, seems to follow no geographic pattern. In other respects the species is virtually monomorphic.

LI. Sectio PREUSSIANI

Malodorous (selenium-scented) perennials of coarse, usually rapid growth and often of short duration, sometimes flowering the first season; *root-crown* superficial; *vesture* basifixed, often scanty; *stipules* free (the lowest rarely shortly connate in *A. Pattersoni); leaves* imparipinnate, with 3–33 jointed leaflets (the terminal one sometimes decurrent in *A. Preussii),* the foliage thick-textured, drying slowly; *racemes* 3–33-flowered, the flowers either ascending or nodding at anthesis, of large or moderate size, the banner 1.4–3.1 cm. long; *calyx-tube* broadly campanulate to cylindric; *petals* purple, pink, ochroleucous, white, or yellowish, regularly graduated, the keel-tip rounded or sharply deltoid; *pod* erect, spreading, or declined, persistent with the clavately thickened pedicel until after dehiscence, sessile or stipitate, scarcely turgid to strongly inflated, the body narrowly ellipsoid to broadly ovoid, obovoid or subglobose, terete or moderately compressed either way, the valves stiffly papery, leathery, or woody, usually not inflexed, or inflexed only as a narrow or rudimentary septum, but in *A. mokiacensis* subbilocular, the cavity either empty or at first filled with pulpy filaments; *dehiscence* primarily apical and through the ventral suture, rarely also tardily basal; *ovules* 20–84.

The sect. *Preussiani* is neither neatly nor succinctly definable in terms of morphological characters. Like most groups built up by accretion around a nucleus, it has come to embrace species which differ widely from one another in important characters, and the section is only perceived as a natural assemblage as the logic of its structure is appreciated. As defined in these pages it consists of three subsections, of which the *Preussiani* proper is perhaps most primitive

and can be considered first. In subsect. *Preussiani* the flowers ascend from the raceme-axis at anthesis, the petals (except in rare albinos) are purple, and the pod is (with two exceptions mentioned below) relatively thin-walled, unilocular (but sometimes a vestigial septum in *A. Crotalariae*), and scarcely or not at all pulpy within the cavity. The group as formulated by Jones consisted of *A. Preussii* with *A. Eastwoodae* as a variety, *A. Crotalariae* under the name *A. limatus*, and *A. ampullarius*. It is modified here by exclusion of the cryptophytic, connate-stipuled *A. ampullarius* and by introduction of *A. mokiacensis*, which differs from *A. Preussii* chiefly in the broad septum, and *A. Beathii*, which combines with the flower of *A. Preussii* the fleshy, inwardly filamentous pod of the following group. Jones's genuine *Preussiani* were transferred by Rydberg (1929) to subgen. *Dermatocystis* of *Phaca*.

Although Jones had already recognized intuitively the relationship between the true *Preussiani* and the *Pattersoniani*, one might be justified, if the transitional *A. Beathii* did not exist, in maintaining the two groups as separate sections. The *Pattersoniani* are two species characterized by a nodding, white or ochroleucous flower, a calyx dorsally gibbous or very strongly oblique at base, and a fleshy, inwardly pulpy-filamentous, ultimately leathery or ligneous pod provided with a narrow, partial septum. This subsection formed in Rydberg's summary revision (1929) the greater part (exclusive of the type-species, *A. asclepiadoides*) of the genus *Jonesiella* and had earlier formed a separate genus *Phacopsis* Rydb.

The third subsection consists of the somewhat isolated *A. sabulosus*, included by Jones and Rydberg in the same group as *A. Pattersoni*. It is a remarkable species of highly individual aspect, standing well apart from the other members of the section in its few, ample leaflets, few-flowered racemes of exceptionally large, ascending, yellowish flowers, and nodding, subsessile, narrowly septiferous but relatively thin-walled pod. The fruit is like that of the genuine *Preussiani* in texture but resembles that of some *Pattersoniani* in form.

Morphological features common to all the *Preussiani* are few, and none of these offers a means of separating the section from sect. *Reventi-arrecti*, which presents a somewhat parallel but even greater range of modification in the flower and pod. It is assumed that the two groups are related. Unlike the *Reventi-arrecti*, the *Preussiani* are restricted to seleniferous soils and depend for their welfare on a supply of selenium either in soluble or convertible form. This physiological specialization, which can be recognized in the smell of the freshly gathered leaves, is perhaps the best differential character of the section. It should be added, however, that the *Preussiani* are apparently not at all closely related to other North American seleniferous groups, such as the *Pectinati, Racemosi*, and *Ocreati*. The latter may be distinguished by their connate stipules and together form a loosely interallied complex of seemingly independent origin.

Key to the Subsections of Sect. Preussiani

1. Leaflets (except in some early leaves, or on rare seedling plants) 9–27 (33); if the *flower* white or ochroleucous then the *racemes* over 10-flowered; *flowers* of moderate size, the calyx 6–14 mm. long; widespread (2)
   2. Flowers (except in rare albinos) purple or purplish, ascending at full anthesis, the calyx little oblique at base; *pod* mostly of thinly leathery or stiffly papery texture, naked or at best thinly filamentous within, and unilocular, but in 2 rare spp. of n. Arizona and s. Nevada either fleshy and pulpy within, or bilocular ..... LI (i). Subsect. *Preussiani*
   2. Flowers white or ochroleucous (rarely roseate), nodding at full anthesis, the calyx dorsally gibbous or at least strongly oblique at base; *pod* fleshy, becoming leathery or subligneous, narrowly septiferous, the valves heavily pulpy-filamentous within ..... LI (ii). Subsect. *Pattersoniani*
1. Leaflets (1) 3–11; *racemes* 6–10-flowered; *flowers* yellowish, very large, the calyx 15–17.5 mm. long; local in Grand County, Utah ..... LI (iii). Subsect. *Sabulosi*

LI (i). Subsectio Preussiani

Leaves imparipinnate, with (7) 9–25 leaflets, the terminal one rarely decurrent; *racemes* 3–25-flowered, the flowers ascending at full anthesis, rarely declined in age; *calyx-tube* deeply campanulate or cylindric, little oblique at base; *petals* purple or pink-purple, the banner 14–28 mm. long; *pod* erect, spreading, or declined, sessile or stipitate, the body cylindric, fusiform, ellipsoid, oblong-ellipsoid, or ovoid, commonly of stiffly papery texture and unilocular, in *A. mokiacensis* bilocular, in *A. Beathii* (passage to subsect. *Pattersoniani*) fleshy becoming woody and narrowly septiferous.—Spp. 5, xerophytes, of the Colorado Basin and the

Mohave and Colorado Deserts, southwestern Colorado to southeastern California, southwestern Arizona, and adjoining Mexico.

ASTRAGALUS sect. PREUSSIANI Jones, Rev. Astrag. 152. 1923 (*"Preussii"*, the genitive ending inadmissible in the category), sens. restr.—Sp. typica: *A. Preussii* Gray.—*Phaca* subgen. *Dermatocystis* sect. *Preussianae* (Jones) Rydb. in N. Amer. Fl. 24: 362. 1929.

Phaca subgen. *Dermatocystis* Rydb. in N. Amer. Fl. 24: 329, in clave. 1929.—Sectio lectotypica: sect. *Preussianae* (Jones) Rydb.

Key to the Species of Subsect. Preussiani

1. Pod erect or ascending, or if declined then stipitate and the stipe at least 2 mm. long, and the valves chartaceous, and not of n. Arizona (2)
   2. Pod (sessile, narrowly ellipsoid) semi- or subbilocular, the septum broad, ± 1.5–2.5 mm. wide; n.-w. Arizona (Mohave County) and extreme s. Nevada ..... 182. *A. mokiacensis*
   2. Pod (variable in shape, usually much inflated, but if narrowly oblong-ellipsoid then stipitate), uni- or subunilocular, the septum rudimentary if present (3)
      3. Ovary and pod glabrous, rarely minutely scabrid-pubescent; *pod* commonly stipitate, but if sessile (*A. Preussii* var. *laxiflorus*) then the flowers relatively small, the banner not over 18 mm., the keel not over 13 mm. long; Colorado Basin and Mohave Desert, 1200 ft. upward (4)
         4. Pod horizontally spreading or declined, borne on weakly ascending and reclining peduncles, therefore commonly humistrate; *stems* short, relatively slender, loosely to quite densely tufted, mostly 2–10 (14) cm. long; local in s.-w. Colorado and s.-e. Utah ..... 180. *A. Eastwoodae*
         4. Pod erect or narrowly ascending from erect peduncles; *stems* commonly stout, erect and ascending in clumps, mostly 1–3.5 dm. long; s. Utah and n. Arizona to s. Nevada and w. Mohave Desert in California ..... 179. *A. Preussii*
      3. Ovary and pod strigulose; *pod* sessile or nearly so; *flowers* large, the banner at least 21 mm. long, the keel at least 17 mm. long; Colorado Desert, California, and immediately adjoining states, below 1000 ft. ..... 181. *A. Crotalariae*
1. Pod declined or deflexed, sessile or subsessile, fleshy becoming leathery or almost woody; local along the Little Colorado River in Coconino County, Arizona ..... 183. *A. Beathii*

179. ASTRAGALUS PREUSSII

Perennial but sometimes flowering the first season, rather coarse and robust, glabrous or nearly so below the inflorescence, the few hairs, when present, either filiform or scalelike, appressed, up to 0.1–0.5 mm. long, confined to the margins and midrib of the leaflets, the malodorous herbage green or yellowish-green, somewhat leathery; *stems* several, erect and ascending, (0.7) 1–3.5 dm. long, simple or few-branched below the middle, distally simple, or the flowering axils (in some populations) bearing a branchlet or spur inserted between petiole and peduncle; *stipules* 2–8 mm. long, the lowest ovate or broader than long, obtuse, papery or early becoming so, the upper ones ovate, deltoid, or lanceolate, herbaceous until late in the season, all decurrent around ⅓–⅞ the stem's circumference; *leaves* (3.5) 4.5–18 cm. long, shortly petioled or the uppermost subsessile, with stiff rachis and (7) 11–25 rather distant leaflets 1.5–27 mm. long, these varying in shape from suborbicular-obcordate through oblong-obovate to linear-elliptic, narrowly lanceolate, or linear and acute, either all of one sort on a given plant, or dimorphic, those of the upper leaves of the narrower type; *peduncles* stout, (2) 3–15 cm. long, usually a little shorter than the leaf; *racemes* loosely (3) 4–16 (22)-flowered, the axis 1–23 cm. long in fruit; *bracts* membranous, pallid or purplish, ovate or lanceolate, 1.5–4 mm. long; *pedicels* ascending, straight, at anthesis (1) 1.5–2.8 mm., in fruit clavately thickened, (2) 2.5–5.5 mm. long; *bracteoles* nearly always 2, sometimes minute; *calyx* (6.4) 8.2–12.3 mm. long, thinly strigulose with black or mixed black and white hairs, the disc 1–2.9 mm. deep, the membranous, reddish or purplish, cylindric or subcylindric tube (5.1) 6–9.7 mm. long,

(2.7) 3–4.8 mm. in diameter, the subulate teeth 1.3–2.6 mm. long; *petals* pink- or (when dried) bluish-purple, sometimes pallid but distally suffused with lilac-purple; *banner* recurved through ± 40°, rhombic-obovate or -oblanceolate, retuse or subentire at apex, (14) 16.5–24 mm. long, (6.4) 7.3–10.6 mm. wide; *wings* (12.6) 14.3–20.5 mm. long, the claws (5.8) 6.7–11.1 mm., the lance-oblong, obtuse, truncate, or obscurely emarginate, nearly straight blades (7.8) 8.7–11.3 mm. long, (1.5) 2.3–3.4 mm. wide; *keel* (11.1) 11.5–19 mm. long, the claws (5.6) 6.3–11.4 mm., the lunately half-elliptic or -oblanceolate blades 5.9–9.3 mm. long, 2.5–3.7 mm. wide, gently incurved through 60–90° to the blunt apex; *anthers* (0.6) 0.7–0.9 (0.95) mm. long; *pod* erect or narrowly ascending, stipitate or subsessile, the stipe up to 7 mm. long, the body narrowly to broadly oblong-ellipsoid or fusiform, inflated but hardly bladdery, (1.2) 1.5–3.2 (4) cm. long, (6) 7–13 mm. in diameter, straight or a trifle incurved, at base rounded, subtruncate, or obconic, abruptly contracted distally into a short, rigidly cuspidate beak, terete or a little compressed either laterally or dorsiventrally, sometimes shallowly sulcate ventrally, the sutures both prominent, the thinly fleshy, green or red-dotted, glabrous or minutely puberulent valves becoming stiffly papery or subcoriaceous, stramineous, not inflexed, the dorsal suture sometimes raised internally and simulating a vestigial septum; *dehiscence* apical, through the gaping beak; *ovules* (20–24) 26–44; *seeds* brown or orange-brown, smooth or nearly so, sometimes mottled with dull purple, 2.4–3.7 mm. long.

Key to the Varieties of A. Preussii

1. Pod stipitate, the stipe (2) 3–7 mm. long; *racemes* short, the axis 1–7 (9) cm. long in fruit; *flowers* large, the calyx (8.9) 9.6–12.3 mm., the keel 13.4–19 mm. long; s.-e. Utah and n. Arizona to extreme s. Nevada and immediately adjoining California ..... 179a. var. *Preussii*
1. Pod sessile or nearly so, the stipe reduced to a thick, obconic neck hardly longer than wide; *racemes* looser, the axis 4–23 cm. long in fruit; *flowers* a little smaller, the calyx (6.4) 8–9.4 mm., the keel 11.1–12.8 mm. long; extreme s.-w. Utah and adjoining Nevada and Arizona; also disjunctly on the w. Mohave Desert, California ..... 179b. var. *laxiflorus*

179a. Astragalus Preussii var. Preussii

Leaflets extremely variable in size and number, generally (7) 11–15 and of broad outline west of the Grand Canyon, 13–23 in the Colorado Basin above the Canyon, in the latter area varying from orbicular to linear, either from the lower to the upper leaves of a single plant, or from plant to plant in a colony, or from colony to colony; *banner* 17.4–24 mm. long.—Collections: 34 (viii); representative specimens cited below.

Alkaline clay flats, talus in canyons, gravelly or sandy washes, and along draws in gullied badlands, confined to selenium-bearing soils derived from sandstone or limestone, 1700–5150 feet, locally plentiful but rather scattered, Colorado Basin in southestern Utah and northern Arizona, west to southern Nevada and extreme east San Bernardino County, California.—Map. No. 72.—Late March to May, the fruit long persistent.

Astragalus Preussii (Charles Preuss, artist with Capt. Fremont's party in the Rocky Mountains and California, 1842–44) Gray in Proc. Amer. Acad. 6: 222. 1864.—"Banks of the Rio Virgen, a tributary of the Colorado in Nevada, near the eastern borders of California, ... Fremont, in second expedition, 1844 ..."—Holotypus, NY! isotypus (fragm.), GH!—*Tragacantha Preussii* (Gray) O. Kze., Rev. Gen. 947. 1891. *Phaca Preussii* (Gray) Rydb. in Bull. Torr. Club 40: 47. 1913. *Rydbergiella Preussii* (Gray) Rydb., Fl. Rocky Mts. 1063. 1917.

Astragalus Preussii var. *latus* (broad, of the pod) Jones in Zoë 4: 36. 1893.—"Collected by me at Green River, Utah, May 7, 1891 ..."—No spm. found at POM with data matching the original publication; presumed isotypus, dated May 6, 1891, NY! The type-collection seems

to have been mixed with that of *A. Preussii* var. *sulcatus,* which was collected May 6 at Westwater but partly labeled Green River—cf. spms. at MO, US.—*A. Preussii* var. *arctus* (strict or close) Sheld. in Minn. Bot. Stud. 1: 130. 1894, a superfluous substitute. *Rydbergiella arcta* (Sheld.) Rydb., Fl. Rocky Mts. 1063 (exclus. descr., p. 501). 1917. *Astragalus arctus* (Sheld.) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Utah & Nev.): 327. 1925. *Jonesiella arcta* (Sheld.) Rydb. in N. Amer. Fl. 24: 402. 1929.

The Preuss milk-vetch is a coarse, ill-scented but rather handsome astragalus, and perplexingly variable. In the type-region west of Grand Canyon, the populations are characterized by few (mostly 11–15) broadly obovate, obtuse or retuse leaflets (*Clokey 8406,* CAS, NY, UC, WIS, WS; *8460,* CAS, NY, UC, WS; *C. B. Wolf 10,533,* CAS, RSA). In the Colorado Basin above the Canyon, the leaflets except in seedling plants (cf. *Cutler 2283,* CAS, NY, WIS) are almost consistently more numerous, commonly 17–25, and vary greatly in outline within a colony, sometimes from leaf to leaf on a single plant. In northern Coconino County, Arizona, the leaflets are mostly small, obovate, retuse or emarginate (*Barneby 12,669,* CAS, NY, RSA); in Emery and Grand Counties, Utah, the lower leaves are composed of oblong-elliptic, obtuse leaflets, but these vary upward along the stems into linear-elliptic, mucronulate or sharply acute ones up to 2.5 cm. in length (*Holmgren & Hansen 3313,* NY, UTC, WS, WTU; *Ripley & Barneby 5400,* CAS, RSA; *Rydberg & Garrett 8436, 8481, 8482,* NY; *Jones* from San Rafael Swell *in 1914,* NY, POM). The aspect of the whole plant changes with the type of leaflet, but the flower and pod remain essentially uniform. Experience with the living plants suggests that the populations in southeastern Utah are on the average taller and of more bushy growth-habit than those in Nevada, and the petals are generally of a more vivid purple. The curious spurs or branchlets inserted between petiole and peduncle at the upper axils are more frequent in the eastern area. Possibly var. *latus* should be revived for the variants in the Colorado Basin; for the present, however, it seems preferable to treat the leaf-variants as representing evolutionary trends too little advanced to deserve taxonomic notice.

179b. Astragalus preussii var. laxiflorus

Leaflets 11–15, broadly obovate, obtuse, or truncate and mucronulate; *banner* 14–17.5 mm. long.—Collections: 13 (o); representative: *Clokey 5862* (CAS, NA, NY, UC, WS); *Eastwood & Howell 9006* (CAS, RSA); *F. W. Gould 1518* (CAS); *Tidestrom 8674* (NA), *9144* (NY).

Gravelly or sandy washes and along draws in gullied badlands, 1200–2500 feet, uncommon, lower Muddy and Virgin Valleys around the common boundary point of Nevada, Utah, and Arizona; isolated, probably on alkaline clay flats at ± 2350 feet, on the southwest Mohave Desert (near Lancaster, Los Angeles County), California.—Map. No. 72.—March to May.

Astragalus Preussii var. laxiflorus (loosely flowered) Gray in Proc. Amer. Acad. 13: 369. 1878.—"Beaverdam, on the Virgen, northeast corner of Arizona, Dr. Palmer (1877)."—Holotypus, *Palmer 104 in 1877,* GH! isotypi, K, MO, NY, US!—*A. Preussii* var. *laxispicatus* (with loose racemes) Sheld. in Minn. Bot. Stud. 1: 130. 1894, a superfluous substitute. *Phaca laxiflora* (Gray) Rydb. in N. Amer. Fl. 24: 363. 1929.

Phaca Davidsonii (Anstruther Davidson, 1860–1932, physician, botanist, entomologist, in s. California from 1889) Rydb. in N. Amer. Fl. 24: 362. 1929.—"Type collected at Lancaster, California, May 12, 1893, *A. Davidson 4* . . ."—Holotypus, GH! isotypi, DS, NY, US!—*A. Crotalariae* var. *Davidsonii* (Rydb.) Munz & McB. ex Munz in Bull. S. Calif. Acad. Sci. 31: 66. 1932.

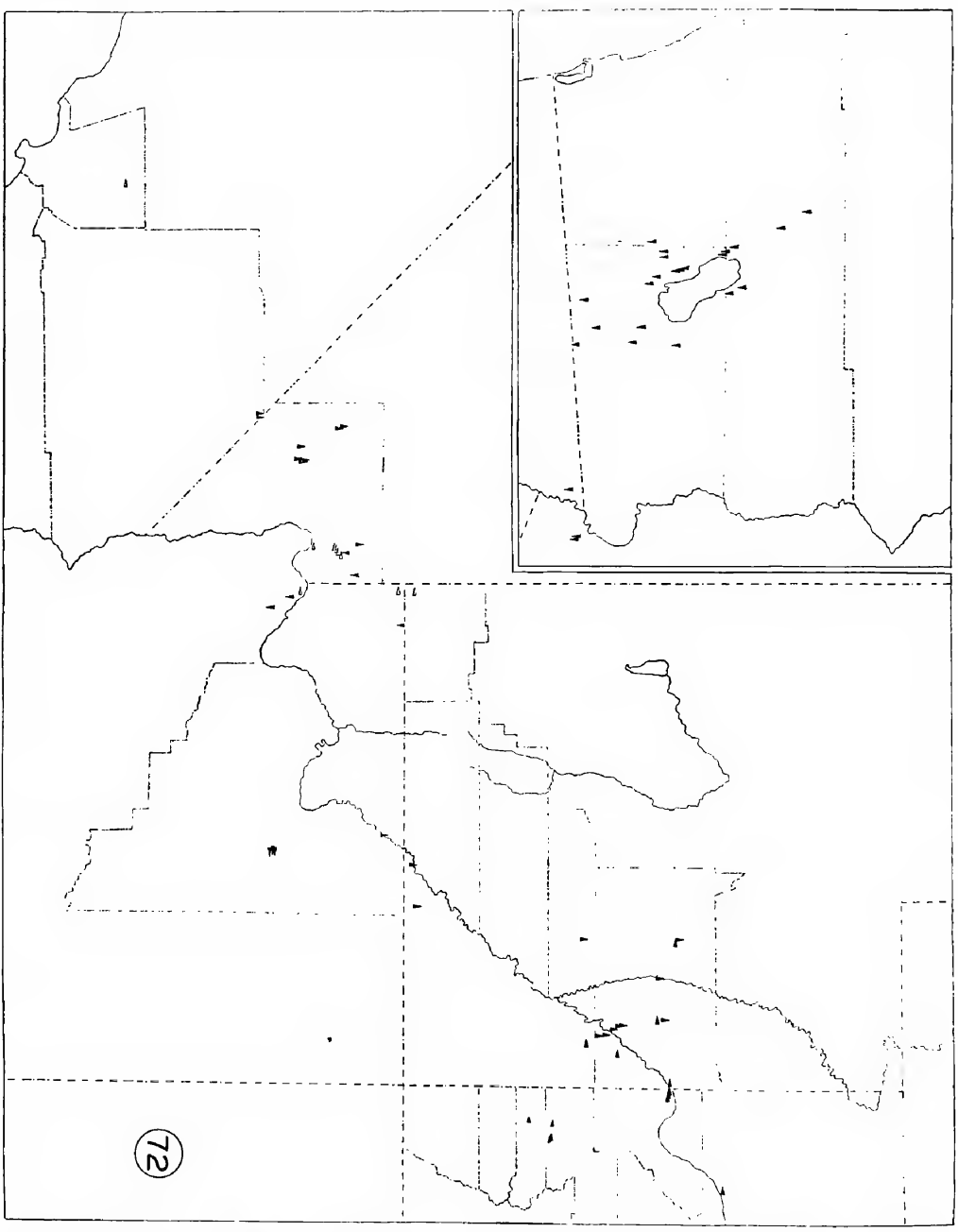
The var. *laxiflorus* is distinguished from var. *Preussii* by its sessile pod and by the greater length of all but some depauperate, subterminal racemes. The name should perhaps be restricted to the populations found in the main area around the head of Lake Mead, which seem to be the progeny of a mutation derived from the typical phase of var. *Preussii* prevalent in southern Nevada. The so-called *Phaca Davidsonii,* isolated at a single point on the Mohave Desert 170 miles to the west, is still poorly known (from one collection, *Elmer 3669,* NY, beside the typus) and may represent a parallel mutation of independent origin. It resembles var. *laxiflorus* closely in habit and pod, but stands out as mildly remarkable for its small flower (calyx ± 6.5 mm., banner ± 14 mm. long), and few (20–22) ovules. Whatever the status of this form, which has been sought vainly in recent years, it is certainly too close to var. *laxiflorus* to be excluded from *A. Preussii* sens. lat. It has been subordinated as a variety to *A. Crotalariae* of the Colorado Desert, but differs from this in its narrow, little-inflated, glabrous pod, almost hairless herbage, and flowers smaller by about one third.

180. Astragalus Eastwoodae

Low, loosely tufted, relatively slender, with a woody taproot and shortly forking, suffrutriculose caudex, glabrous except for a few scattered, filiform or scalelike, commonly black hairs on the calyx, pedicels, and margins of the bracts, the thick-textured herbage yellowish-green; *stems* several or numerous, decumbent and incurved-ascending, 2–10 (14) cm. long, simple or bearing short spurs at 1–3 nodes preceding the first peduncle, and also sometimes between peduncle and petiole, the internodes mostly short, some up to 3 cm. long, mostly shorter; *stipules* submembranous early becoming papery-scarious, 2–6.5 mm. long, broadly ovate, triangular-ovate, or ovate-acuminate, the lowest often broader than the stem, decurrent around half to nearly the whole stem's circumference; *leaves* 3–13 cm. long, shortly petioled, with slender but rather stiff rachis and (9) 13–25, usually distant, scattered, narrowly elliptic, lance-elliptic, or oblanceolate, acute or subacute or (especially in some lower leaves) oblong-obovate to obovate, obtuse, flat or loosely folded leaflets (1.5) 2.5–10 mm. long, the terminal one sometimes confluent with the rachis; *peduncles* 2–10.5 cm. long, ascending at anthesis, divergent or declined in fruit; *racemes* shortly but losely 3–7-flowered, the flowers horizontally spreading or declined in age, the axis little elongating, 0.5–3.5 (4) cm. long in fruit; *bracts* submembranous, becoming papery-scarious, ovate or broadly ovate-triangular, 1.5–4.5 mm. long; *pedicels* at anthesis ascending, 1.5–2 mm. long, in fruit thickened, arched outward, 2–3.5 mm. long; *bracteoles* 2; *calyx* 10–12.2 mm. long, the ± oblique disc 1.6–2.1 mm. deep, the broadly cylindric, membranous, reddish tube 8–9.5 mm. long, 3.6–4.1 mm. in diameter, the subulate teeth 1.3–2.7 mm. long, the whole becoming papery, ruptured distally but marcescent around the stipe; *petals* pink-purple; *banner* recurved through ± 45°, broadly rhombic-oblanceolate, notched, 18.5–21.4 mm. long, 8–11 mm. wide; *wings* 16.6–20.4 mm. long, the claws 9.2–10.7 mm., the linear-oblong, -oblanceolate, or -elliptic, obtuse blades 8.3–12 mm. long, 2.3–2.8 mm. wide; *keel* 15.4–17.7 mm. long, the claws 9.3–10.7 mm., the lunately elliptic or narrowly half-obovate blades 6.9–8.4 mm. long, 2.8–3.4 mm. wide, gently incurved through 80–90° to the rounded apex; *anthers* 0.8–0.9 mm. long; *pod* widely divergent or declined, commonly humistrate, stipitate, the straight or slightly incurved stipe 1.5–4.5 mm. long, the inflated body subsymmetrically or somewhat obliquely ovoid or oblong-ellipsoid, 1.4–2.6 cm. long, (7) 8–14.5 mm. in diameter, turbinately or subtruncately contracted at base, abruptly narrowed distally into an erect, triangular-acuminate, laterally compressed beak ± 2.5–5 mm. long, otherwise subterete or a little obcompressed, then shallowly grooved along one or both sutures, the thinly fleshy, pale green or red-tinged, glabrous or minutely scabrid-puberulent valves becoming papery, stramineous, subdiaphanous, finely reticulate, smooth internally, not inflexed; *ovules* 20–38; *seeds* brown, smooth but dull, deeply notched at the hilum, 1.8–3.3 mm. long.—Collections: 14 (iv); representative: *Jones* (topotypus) *in 1899* (NY, POM); *Jones* (from San Rafael Swell) *in 1914* (POM); *W. A. Weber 3881* (CAS); *Payson 278* (RM, TEX); *Barneby 12,745* (CAS, NY, POM, RSA, UTC), *13,058, 13,064* (CAS, NY, RSA).

Along draws and creek beds in low gravelly clay hills, on gullied badlands, and on clay banks or benches of arid escarpments, 4300–6250 feet, local but forming colonies, valleys of the Grand, Dolores, and San Miguel Rivers in western Colorado, from southcentral Garfield to San Miguel County, west around the foothills of the La Sal Mountains in southern Grand and adjoining San Juan County, Utah, and apparently disjunctly in the San Rafael Swell, Emery County.—Map No. 72.—April to June, the fruit sometimes persisting over winter on withered stems.

ASTRAGALUS EASTWOODAE (Alice Eastwood, 1859–1953, long curator of botany at CAS) Jones in Zoë 4: 368. 1894, based on *A. Preussii* var. *sulcatus* (grooved, of the pod) Jones in Zoë 4: 37. 1893.—"Collected by me . . . May 6, 1891, at Westwater, Colo. [perhaps across the Utah line in Grand County], and in fruit only by Miss Alice Eastwood, at Cane Spring, Utah, May, 1892."—Holotypus, *Jones in 1891,* POM! isotypi, NY, RM, and labeled "Green River," but correctly dated, MO, US! paratypi, *Eastwood in 1892,* CAS, POM!—*Phaca Eastwoodae* (Jones) Rydb. in Bull. Torr. Club 32: 664. 1905 *("Eastwoodiae"). A. Preussii* var. *Eastwoodae* (Jones) Jones, Rev. Astrag. 154, Pl. 33. 1923.



Map No. 72. Right, parts of Utah, Arizona, southern Nevada, and southeastern California. Range of *A. Preussii*: ◠ var. *Preussii*; and ◊ var. *laxiflorus*; of ◖ *A. Eastwoodae*; of ◗ *A. Beathii;* and of ◡ *A. mokiacensis*. Top left, southern California. Range of *A. Crotalariae.*

The Eastwood milk-vetch is very closely related to *A. Preussii.* Neither the flowers nor the fruits offer differential characters of any substance, and Jones's first and last estimate of it as a marked variety is perhaps the correct one. Nevertheless, the plants differ so greatly from all known forms of *A. Preussii* in their short stems and declined or truly pendulous pods that it is hard to think of *A. Eastwoodae* as anything but a distinct specific type. Just as the broad-leaved phase of *A. Preussii* seems to have given rise in southern Nevada to a mutant var. *laxiflorus,* so *A. Eastwoodae* is presumably derived from the narrow-leaved *A. Preussii* of the Colorado Basin. The forms of var. *Preussii* sympatric or nearly so with *A. Eastwoodae* in southeastern Utah, although similar in foliage and flower, are taller and coarser plants, with erect and ascending stems mostly 2–3.5 dm. long and erect pods of thicker and stiffer texture.

181. Astragalus Crotalariae

Coarse, leafy, ill-scented but handsome perennial, of rapid growth, often flowering the first season, strigulose, strigulose-pilosulous, or exceptionally pilose with fine, straight, appressed and often (especially the stems upward) some narrowly ascending hairs up to 0.5–0.9 (1.2) mm. long, the herbage green, yellowish-green, or the growing tips cinereous, rarely cinereous throughout, the leaflets commonly glabrous but sometimes thinly pubescent above; *stems* usually several or numerous, erect and ascending in bushy clumps, or in seedling plants erect and solitary, 1.5–5 (6) dm. long, angular-striate and hollow when vigorous, simple or commonly spurred at 1 or several nodes preceding the first peduncle, floriferous upward from near or above the middle; *stipules* thinly herbaceous becoming papery, pallid, fragile in age, broadly deltoid or ovate, commonly broader than long or broader than the stem, 4–12 mm. long, several-nerved, decurrent around half to nearly the whole stem's circumference, the obtuse or shortly acuminate blades recurved or reflexed; *leaves* 5–14 (16.5) cm. long, the lower ones petioled, the upper subsessile, with stout, tapering rachis and 9–17 (19, or in some seedlings only 3–9) obovate-cuneate, broadly oblong-obovate or -elliptic, or (in some leaves) suborbicular-obcordate, retuse or emarginate, flat, thick-textured leaflets (5) 7–30 (35) mm. long; *peduncles* stout, erect, (5) 7–17 cm. long, a little longer or shorter than the leaf; *racemes* loosely, or at first rather closely, 10–25-flowered, the flowers ascending at a wide angle, the axis somewhat elongating, (2) 3–10 cm. long in fruit; *bracts* submembranous, broadly ovate, ovate-acuminate, or lanceolate, 1.5–4 mm. long; *pedicels* ascending, straight or a trifle arched outward, at anthesis 1.2–2.2 mm., in fruit thickened, 2.8–4.5 mm. long; *bracteoles* 2, rarely vestigial or 0; *calyx* (7.6) 8–12.3 mm. long, strigulose or pilosulous with black, fuscous, or mixed black and white hairs, the oblique disc 1.2–2 mm. deep, the submembranous, deeply campanulate or subcylindric, red- or purple-tinged tube (6.3) 6.7–9.7 mm. long, (3.6) 3.9–6.5 mm. in diameter, the subulate or triangular-subulate teeth (1.3) 1.8–2.7 mm. long, the dorsal one often the shortest, the ventral pair sometimes broadly deltoid, the whole becoming papery, fragile, ruptured but usually marcescent, rarely tardily circumscissile; *petals* rosy- or magenta-purple, drying violet, sometimes all white; *banner* recurved through ± 40°, broadly to narrowly rhombic-oblanceolate, shallowly notched, 21–27 (28) mm. long, 8.2–13 (14) mm. wide; *wings* 19.5–24 (25) mm. long, the claws (8.8) 9.4–11.3 mm., the linear-oblong or -elliptic, obtuse, nearly straight blades (11.1) 12.4–15 mm. long, 2.9–4.8 mm. wide; *keel* 17.4–21 mm. long, the claws (8.8) 9.2–11.3 mm., the half obovate or lunately half-elliptic blades 8.9–11 mm. long, (3) 3.2–4.8 mm. wide, incurved through 50–90° to the rounded apex; *anthers* (0.7) 0.8–1 mm. long; *pod* ascending or somewhat spreading, subsessile, the broadly ellipsoid, oblong- or ovoid-ellipsoid body (2) 2.3–3 cm. long, 1–1.4 cm. in diameter, inflated but hardly bladdery, cuneately or truncately contracted at base into a thick, turbinate, stipelike neck 1–1.5 mm. long, narrowed distally into a very short, erect or slightly incurved, triangular-acuminate beak tipped by the persistent

style-base, the whole slightly compressed laterally, bicarinate by the slender sutures (these subequally convex as seen in profile or the ventral one less so), the lateral faces broadly and plumply rounded, the green, thinly fleshy, sparsely to quite densely strigulose valves becoming stramineous, papery, finely but prominently cross-reticulate, sparsely filamentous within, not inflexed, or inflexed as a vestigial septum up to 0.4 mm. wide; *dehiscence* apical and downward through the ventral suture; *ovules* (24) 28–38; *seeds* brown, sometimes speckled with purple, nearly smooth or sparsely punctuate, dull, 3–4.3 mm. long.—Collections: 38 (iii); representative: *Brandegee* (from San Felipe Creek) *in 1901* (NY); *Abrams 3150* (NY); *A. & R. Nelson 3229* (NY, RM, SMU, WS); *C. B. Wolf 8439* (CAS, NY); *H. & S. Parks 0361* (CAS, NY).

Plains, valley floors, washes, and outwash fans in the foothills of desert mountains or on open desert, in sandy or gravelly soils, sometimes on dunes, rarely along irrigation ditches, with *Larrea,* -220–800 feet, locally abundant in the Colorado Desert, southeastern California, from the head of the Salton Sea south to Carrizo Valley, southeast through Imperial Valley to the Yuma Desert in ex treme southwestern Arizona, and south just into Baja California.—Map No. 72.—January to April.

ASTRAGALUS CROTALARIAE (Bth.) Gray in Proc. Amer. Acad. 6: 216. 1864, based on *Phaca Crotalariae* (resembling some *Crotalaria* in the pod) Bth., Pl. Hartw. 309. 1848.—"Juxta Monterey legit Coulter."—Holotypus, *Coulter 436,* labeled "Monterey, California," K (herb. Benth.)!—*Tragacantha Crotalariae* (Bth.) O. Kze., Rev. Gen. 944. 1891.

Astragalus limatus (polished, hence fine or elegant) Sheld. in Minn. Bot. Stud. 1: 126. 1894.—"Collected near Indian wells on the Colorado desert in south-western California, C. R. Orcutt, February, 1890 . . . "—Holotypus, MINN! isotypus *(Orcutt 2040),* US!—*A. Preussii* var. *limatus* (Sheld.) Jeps., Man. Calif. 566, fig. 555. 1925.

The rattle-box milk-vetch, *A. Crotalariae,* is by far the handsomest astragalus found on the floor and surrounding outwash fans and sand plains of the Salton Sink, readily known by its long flowers and stiffly papery, swollen fruits. The plants are potentially perennial and, granted the right conditions for growth, form vigorous clumps of stems arising from a thick, woody taproot; but they mature rapidly and often flower within three or four months after germination of the seed. Depending on rainfall and on timing of the rains, the populations vary greatly in numbers from year to year. After several years of drought only a few aged and ailing veterans may be found along a wash where a few seasons earlier, following one or especially two successive wet winters, the plants could be numbered in the thousands, thronging the interspaces between the larreas for mile on mile. An albino form, with pure white petals but either purple or pallid calyx, is rather frequent, and the mutation is probably inherited, for sometimes whole colonies of white-flowered plants are found among the usual purples.

The misleading data furnished by Coulter for this and other desert species, encountered on his journey from Monterey to the mouth of the Gila River in 1832, has been the source of lasting confusion. The epithet *Crotalariae* was applied by Gray to *A. Nuttallii,* the only astragalus with bladdery pod found in the immediate vicinity of Monterey Bay; and later by Torrey to *A. oocarpus,* a species with rather similar inflated fruits but much smaller, ochroleucous flowers. The material in Bentham's herbarium at Kew was examined by I. M. Johnston (fide Jones, Contrib. West. Bot. 15: 69, the name misspelled *"crotalarioides"*) and then first identified positively with *A. limatus* Sheld.; the determination is confirmed by Bentham's excellent description, and by re-examination of Bentham's specimen.

182. ASTRAGALUS MOKIACENSIS

Robust, caulescent perennial, possibly sometimes of short duration, strigulose with straight, appressed or subappressed hairs up to 0.45–0.7 mm. long, the stems glabrescent at base, cinereous distally, the herbage green or cinereous, the leaflets pubescent on both sides, or thinly so to glabrate, rarely truly glabrous above; *stems* erect and ascending in clumps, simple above the immediate base or branched at 1–4 nodes preceding the first peduncle, 1–4 dm. long; *stipules* subherbaceous becoming papery, broadly triangular-acuminate, 3–7 mm. long, semiamplexicaul-decurrent, the upper ones mostly deflexed; *leaves* 5–13 cm. long,

shortly petioled, with 7–21 broadly obovate, obovate-cuneate, or suborbicular, mostly emarginate, flat leaflets 5–19 mm. long; *peduncles* stout, erect, 4–11 (14) cm. long, longer or shorter than the leaf; *racemes* 14–24-flowered, rather densely so at early anthesis, the flowers ascending at a wide angle, the axis elongating, 4–13 cm. long in fruit; *bracts* lanceolate, submembranous, pallid or purplish, 1.5–4 mm. long; *pedicels* ascending, at anthesis 1–1.5 mm., in fruit thickened, 2–2.5 mm. long; *bracteoles* apparently 0; *calyx* thinly strigulose with black, white, or mixed hairs, 7–9.2 mm. long, the oblique or subsymmetric disc 1.1–1.4 mm. deep, the deeply campanulate tube 5–6.5 mm. long, 2.8–3.8 mm. in diameter, the subulate teeth 1.7–2.7 mm. long, the whole becoming papery, ruptured, marcescent; *petals* purple, drying violet; *banner* recurved through ± 50°, broadly rhombic-obovate or -oblanceolate, deeply notched, (14) 16.3–18.2 mm. long, 8–12.4 mm. wide; *wings* (13.4) 15–16.6 mm. long, the claws (4.5) 5.3–7.3 mm., the narrowly oblanceolate or linear-oblong, obtuse or truncate, slightly incurved or straight blades 9.2–11.1 mm. long, 2.3–2.7 mm. wide; *keel* 14.4–15.7 mm. long, the claws 5.2–7.2 mm., the broadly half-obovate blades 8.3–10 mm. long, 3.4–3.9 mm. wide, incurved through 60–90° to the rounded apex; *anthers* 0.6–0.8 mm. long; *pod* ascending or spreading and incurved-ascending, sessile, oblong-ellipsoid, (1.4) 1.7–2.5 cm. long, (4.5) 5–7 mm. in diameter, straight or gently incurved, broadly rounded and then turbinately contracted at base, narrowed at apex into a stiff subulate cusp 2–4 mm. long, subterete at first, becoming sulcate ventrally, carinate by the thick, 3-ribbed ventral suture, the somewhat fleshy, green or purple-dotted, glabrous or minutely puberulent valves becoming stiffly papery or almost leathery, stramineous, inflexed below the beak as a partial or almost complete septum 1.7–2.5 mm. wide; *ovules* 26–35; *seeds* unkown.—Collections: 5 (o); representative: *Jones 5058* (NY, POM); *Goodding Sel. 3-41, Sel. 21-41* (RM); *Gullion 450* (RM, UTC).

Bluffs, cliff terraces, and gullied badlands, ± 3000–4000 feet, local and apparently rare, known only from valleys and canyons of the Colorado and Virgin Rivers in northern Mohave County, Arizona, and eastern Clark County, Nevada. —Map. No. 72.—April to June.

ASTRAGALUS MOKIACENSIS (of Mokiak Pass) Gray in Proc. Amer. Acad. 13: 367. 1878 (*"Mokiacensis"*).—"Mokiak Pass, on the borders of Utah and N. W. Arizona, Dr. Palmer, 1877."—Holotypus, *Palmer 105 in 1877*, GH! isotypi, K, NY (2 sheets), POM (fragm.), US! —*A. lentiginosus* var. *mokiacensis* (Gray) Jones, Rev. Astrag. 126, pro parte. 1923. *Tium mokiacense* (Gray) Rydb. in N. Amer. Fl. 24: 398. 1929.

The Mokiak milk-vetch, a pitfall and a snare to three generations of botanists, is still poorly known and perhaps wrongly placed among the *Preussiani*. Nothing has been learned about its reaction to selenium in the soil; but judged from exterior morphology alone, the species seems closely related to *A. Preussii*. Around the head of Lake Mead *A. mokiacensis* and *A. Preussii* var. *laxiflorus* grow close together, and there is no obvious way of distinguishing the two until the fruits have formed. The fruit of *A. Preussii* is strictly unilocular, that of *A. mokiacensis* is fully or almost bilocular, but in *A. Crotalariae* often and in *A. Beathii* always there is some indication of a rudimentary (or incipient) septum, so the addition of *A. mokiacensis* to sect. *Preussiani* introduces no new morphological feature. The septum is merely better developed in this species.

Until quite recently *A. mokiacensis* has been known only from Palmer's type-collection (very likely not from Mokiak Pass itself, but from farther south along Grand Wash) and from material collected by Jones at Mica Spring in the Virgin Mountains, just west of Grand Wash in Nevada. These two classic collections were early associated by Jones with plants collected by Lemmon (*Nos. 3116, 3326*, GH!) along the Colorado River at Peach Springs and downstream toward Fort Mohave. The pod of Lemmon's plant is similar to that of *A. mokiacensis* in form but is densely pubescent, and unlike that of the *Preussiani* disjoints readily from the receptacle when ripe. Watson identified the Lemmon gatherings as *A. ursinus*, but the flowers are too large to fit well with the typus of that imperfectly known entity, and they are

now interpreted as representing an unusual form of *A. lentiginosus* var. *palans*. In his Revision, Jones united *A. ursinus* and *A. Wilsonii* with *A. mokiacensis* as one variety of *A. lentiginosus*, and it seems probable that he arrived at this decision after transferring his concept of genuine *A. mokiacensis* to the species collected by Lemmon. However that may be, the original *A. mokiacensis* was lost to view, and even when Rydberg revived it as a species of *Tium* (Rydberg, 1931, p. 406) it remained encumbered with the Lemmon collections which supplied some of the supposed critical characters. The same error, by now so heavily documented as to become almost holy writ, was perpetuated in my revision of *A. lentiginosus* (1945, p. 137), and a new element of absurdity introduced in the form of an unnamed (but described) form, *A. mokiacensis* β, which, on account of its inflated pod combined with the flower and habit of genuine *A. mokiacensis*, seemed to link the latter even more firmly to the *A. lentiginosus* complex. This form is recognized in these pages as an independent *A. lentiginosus* var. *ambiguus*, but is perhaps still germane to a discussion of *A. mokiacensis* because of the similarity in general appearance.

In northern Mohave County, Arizona, and Clark County, Nevada, there are five astragali, *A. Preussii* var. *Preussii* and var. *laxiflorus*, *A. mokiacensis*, and *A. lentiginosus* var. *palans* and var. *ambiguus*, which occupy similar sites and are so much alike at anthesis (each to at least one, commonly to several of the others) that well-formed fruit is often required for certain identification. The pod of *A. Preussii* is truly unilocular and persistent; that of *A. lentiginosus* is fully bilocular and deciduous; that of *A. mokiacensis* is persistent but provided with a broad septum. The pods of var. *laxiflorus* and var. *ambiguus* are bladdery or at least greatly inflated, in contrast to the narrowly ellipsoid pods of var. *palans* and *A. mokiacensis*, but the pod of var. *Preussii* varies from slenderly fusiform to broadly oblong-ovoid. So far as the fruit alone is concerned, *A. Preussii* var. *Preussii* and *A. lentiginosus* var. *palans* possess all the morphological ingredients which would be needed in theory to create the other three forms. It seems possible that *A. mokiacensis* at least, and very possibly also var. *laxiflorus* and var. *ambiguus* are recombination types derived from a hybrid between *A. Preussii* and some variety of *A. lentiginosus*, presumably var. *palans*, but conceivably var. *yuccanus*, which extends into the area under discussion from its center of abundance farther south. The hypothesis is in harmony with what is known of the distribution of the species involved and would explain the odd dispersal of *A. Preussii* var. *laxiflorus* as an enclave within the range of the widespread var. *Preussii*. The whole question will deserve closer scrutiny as the canyons of the Colorado River downstream from Peach Springs become better known botanically.

183. Astragalus Beathii

Coarsely robust, ill-scented perennial, nearly glabrous below but becoming strigulose distally with filiform, or flattened and scalelike, appressed or subappressed hairs up to 0.35–0.7 mm. long, the herbage deep green, the leaflets of the lower leaves often glabrous on both sides, those of the upper ones glabrous above; *stems* several or numerous, (1.5) 2–6 dm. long, mostly stout and fistular toward the base, striate or sulcate, purple-tinged becoming stramineous, simple or nearly so; *stipules* submembranous, greenish or purplish, early becoming pallid and papery-scarious, 3–9.5 mm. long, strongly decurrent around half, or the lowest around nearly the whole stem's circumference, the broadly deltoid or triangular-acuminate blades mostly reflexed; *leaves* 6–12 (15) cm. long, shortly petioled, with 11–21 (23) narrowly elliptic-oblanceolate and obtuse varying into broadly obovate or oblong-obovate and retuse, flat, thick-textured leaflets 5–25 mm. long; *peduncles* stout, incurved-ascending, (2.5) 4–10 cm. long, a little shorter, or the first a little longer than the leaf; *racemes* 10–27-flowered, rather dense at first anthesis, the flowers ultimately spreading-ascending, the axis 3.5–10 cm. long in fruit; *bracts* membranous or broadly membranous-margined, ovate-triangular, or lanceolate, 2–4.2 mm. long; *pedicels* at anthesis straight, ascending, 0.9–2 (2.5) mm., in fruit greatly thickened, arched outward, 2.2–3 mm. long; *bracteoles* commonly 2, usually conspicuous, rarely 0; *calyx* (7.7) 8.2–10.5 mm. long, either densely or only minutely and sparsely black- (rarely white-) strigulose, the slightly oblique disc (1.3) 1.5–2 mm. deep, the membranous, campanulate or subcylindric, purplish or deep reddish-purple tube (5.3) 5.7–7.8 mm. long, (3) 3.4–4.5 (5) mm. in diameter, the triangular-subulate teeth (1.8) 2–3.1 mm. long, the ventral

pair often broadest and shortest, the whole becoming papery, ruptured, marcescent; *petals* bright purple (drying violet), the wing-tips paler or white, more rarely all pure white, or "pale-blue"; *banner* recurved through ± 40°, broadly rhombic-elliptic or -ovate, shallowly or deeply notched, (17) 20–25 (27.7) mm. long, (8.5) 10–12 mm. wide; *wings* (13.4) 15.4–19.5 (21.8) mm. long, the claws (6) 6.5–8.2 mm., the oblong-oblanceolate or linear-oblong, obtuse, obliquely truncate, or obscurely emarginate, nearly straight blades (8.5) 11–14.8 (16.9) mm. long, (2.6) 3.1–4.1 mm. wide; *keel* (9.6) 11.2–16.4 mm. long, the claws (6.2) 6.8–9 mm., the lunately half-elliptic blades (7.1) 7.5–10.2 mm. long, 3.2–4.2 mm wide, incurved through 45–80° to the bluntly triangular apex; *anthers* (0.7) 0.8–1 mm. long; *pod* deflexed or declined, sessile or nearly so (the stipe not over 0.6 mm. long, nor longer than wide), narrowly to plumply oblong-ellipsoid, straight or a trifle incurved, (2) 2.5–3.9 cm. long, 7–11 mm. in diameter, cuneately attenuate at base, abruptly contracted distally into a triangular, rigidly cuspidate beak, subterete when first formed, becoming a little obcompressed when dry, flattened or low-convex ventrally, flattened or shallowly grooved dorsally, the sutures both thick and cordlike, the dorsal one sometimes undulate, the thick, fleshy, green or purplish-green, glabrous or minutely strigulose, inwardly pulpy-filamentous valves becoming stiffly leathery, stramineous, cross-reticulate and wrinkled lengthwise, inflexed as a narrow septum 1.3–2.3 mm. wide; *dehiscence* apical and downward through the ventral suture, the beak slightly gaping; *ovules* 29–52; *seeds* ocher- or chestnut-brown, sometimes purple-dotted, smooth but dull, 3.2–4.1 mm. long.—Collections: 11 (i); representative: *C. L. Porter 2809* (WS); *Beath H185* (MO, WS); *Deaver 1982* (CAS); *Ripley & Barneby 4880* (CAS, RSA).

Sandy flats, red clay knolls, and gullied washes in badlands, on selenium-bearing soils derived from sandstone, 4000–4800 feet, forming extensive and conspicuous colonies but extremely local, known only from the lower valley of the Little Colorado River within a radius of ± 6–7 miles of Cameron, Coconino County, Arizona.—Map No. 72.—Late March to May, the fruit long persistent on withered stems.

ASTRAGALUS BEATHII (Orville Andrew Beath, 1884– , research chemist at University of Wyoming, noted for work on selenium in plants) C. L. Porter in Madroño 6: 18, Pl. 3. 1941.—"Type. Two miles south of Cameron, Coconino County, Arizona, June 14, 1939, *L. N. Goodding Sel. 34–39* . . . "—Holotypus, RM! isotypi, ARIZ, MO!

The Beath milk-vetch is a coarse, nevertheless handsome species, remarkable for its narrow range and for the amount of variation encompassed within the few populations known to exist. In several respects it is intermediate between subsect. *Preussiani* and subsect. *Pattersoniani*, combining the ascending, normally purple flower of the former with the succulent, ultimately subligneous, inwardly pulpy-filamentous pod of the latter. The pod varies greatly in size and may be either glabrous or puberulent, and the ovules vary in number from about fifteen to twenty-five pairs. The calyx is ordinarily purplish or deep reddish-purple, but the petals vary from a vivid shade of purple, which turns violet in drying, through successively paler shades of lavender-purple into a pure albino white. The variation is of a sort that might reasonably be expected of an imperfectly stabilized hybrid involving some forms of *A. praelongus* and *A. Preussii*. Typical *A. praelongus*, which might supply the factors for a spreading, sessile, semibilocular pod of succulent texture, sometimes white flowers, and sometimes numerous ovules, is widely dispersed over northern Arizona and has been collected close to Cameron in the direction of Tuba City. The var. *Preussii*, relatively few-ovulate and closely resembling *A. Beathii* in form, orientation, and normal coloring of the flowers, is rare in Arizona and not known to occur within fifty miles of the Painted Desert. However its range as traced up to the present is discontinuous, and stations along the Colorado between Navajo Bridge and southern Nevada are to be expected.

LI (ii). Subsectio PATTERSONIANI

Leaflets 11–29 (33), all jointed; *racemes* 10–33-flowered, the flowers nodding at full anthesis; *calyx-tube* broadly campanulate to cylindric, dorsally gibbous (or

at least very strongly oblique) at base, in age either marcescent or circumscissile; *petals* white or ochroleucous (exceptionally roseate), the banner 14.6–23.5 mm. long; *pod* erect or spreading, sessile or stipitate, narrowly ellipsoid to broadly ovoid, obovoid, or subglobose, the fleshy valves becoming stiffly leathery or subligneous, inflexed as a narrow, sometimes obscure septum.—Spp. 2, xerophytes, of the Colorado Basin and west slope of the Colorado Rocky Mountains, extending west to southern Nevada and northwestern Arizona, and southeast to southern and northeastern New Mexico and extreme western Texas.

ASTRAGALUS sect. PREUSSIANI subsect. PATTERSONIANI Jones, Rev. Astrag. 153, in clave. 1923 (*"Pattersoni,"* the genitive ending inadmissible in the category).—Sp. typica: *A. Pattersoni* Gray.

Phacopsis Rydb. in Bull. Torr. Club 32: 661. 1905.—Generitypus: *P. praelongus* (Sheld.) Rydb. = *A. praelongus* Sheld.—*Rydbergiella* Fedde & Sydow in Bot. Jahresb. 33[1]: 534. 1905 (non *Phacopsis* L.-R. Tul., a genus of fungi). *Astragalus* subgen. *Rydbergiella* (Fedde & Sydow) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Utah & Nev.): 318. 1925.

Jonesiella sensu Rydb. in N. Amer. Fl. 24: 401–404, pro max. parte, exclus. typ.

The *Pattersoniani* are a perplexing group, their taxonomy and nomenclature have long been in an insecure state. The limits of the subsection were drawn by Jones in the first place to include a polymorphic *A. Pattersoni* equivalent to *A. Pattersoni* and *A. praelongus* of this account and the very distinct *A. sabulosus,* here transferred to a monotypic subsection. The genus *Phacopsis* or *Rydbergiella* was precisely conterminous with the subsection as defined here, but was reduced by Rydberg himself, in his summary revision, to *Jonesiella* (= the non-seleniferous, monotypic sect. *Pachyphyllus*). Out of the same group of plants which Jones had interpreted as *A. Pattersoni* with an ambiguously defined var. *praelongus,* Rydberg finally described no less than six species of *Jonesiella,* some of which were later accepted as distinct *Astragali* by C. L. Porter. The systematic treatments of the *Pattersoniani* have been based hitherto primarily on features of the pod, but the fruit is far too variable to be suited to this purpose. The following account emphasizes floral morphology, with what are believed to be much more natural results. Two species are maintained in the group, *A. Pattersoni* and *A. praelongus,* the latter composed of three varieties.

Key to the Species of Subsect. Pattersoniani

1. Calyx-tube broadly campanulate, 4.4–6.5 (7.5) mm. long, 3.5–5.4 (6) mm. in diameter, the teeth (0.3–6.6 mm. long) erect or nearly so; *calyx* and petals ochroleucous, nearly concolorous (the petals exceptionally pinkish); *blades* of the keel half-obovate, incurved through 90–105° to the blunt rectangular apex; *pod* either more than 1 cm. in diameter, or contracted at base into a thick stipe or stipelike neck at least 1 mm. long; *ovules* (40) 44–84 ..... 184. *A. praelongus*
1. Calyx-tube cylindric or subcylindric, (6) 6.5–8.8 mm. long, the teeth (2.3–6.8 mm. long) commonly setaceous and divergent or decurved in age; *calyx* and petals pure white (the calyx sometimes reddish-tinged); *blades* of the keel lunately half-elliptic, incurved through less than 90° to the rather sharply triangular apex; *ovules* 22–38 ..... 185. *A. Pattersoni*

184. ASTRAGALUS PRAELONGUS

Coarse and ordinarily tall, either nearly glabrous, or the upper stems, lower surface of the leaflets, and the inflorescence thinly strigulose with straight, appressed hairs up to 0.3–0.65 (1) mm. long, the thick-textured herbage either green or pallidly glaucescent; *stems* several, erect and ascending in clumps from an at length shortly forking, indurated base, (1.5) 2–6 (8) dm. long, simple or bearing short spurs or branchlets near the base (and sometimes also inserted between peduncle and petiole distally); *stipules* thinly herbaceous becoming papery-scarious, 2.5–7 (9) mm. long, the lowest often broader than long, the upper ones commonly deltoid and reflexed, all ± decurrent around ⅓–¾ the stem's circumference; *leaves* 4–18 (22) cm. long, all petioled or the uppermost subsessile, with (7) 11–27 (33) obovate, oblong-obovate, lanceolate, or oblanceolate, obtuse or retuse, or in some upper (all) leaves elliptic and acute leaflets (3) 8–35 (50)

mm. long; *peduncles* stout, erect, 6–26 cm. long; *racemes* 10–25 (33)-flowered, rather dense at early anthesis, the reflexed flowers then retrorsely imbricated, becoming looser, the axis 3.5–13 (16) cm. long in fruit; *bracts* membranous, ovate or lanceolate, 1.5–5 (12) mm. long; *pedicels* at anthesis ascending or a trifle arched outward, (1) 1.5–3 mm. long, in fruit ascending, straight, clavately thickened, (3.5) 4–7 mm. long; *bracteoles* 2, minute, or lanceolate and up to 3.5 mm. long; *calyx* 5.8–13 (14) mm. long, glabrous or thinly strigulose with black or white hairs 0.05–0.5 (0.75) mm. long, the strongly oblique, fleshy disc 0.9–1.7 (2) mm. deep, the tube 4.4–6.5 (7.5) mm. long, 3.5–5.4 (6) mm. in diameter, dorsally gibbous at base, the lance-subulate to broadly deltoid teeth 0.3–5.5 (6.6) mm. long, all erect, or the lateral and dorsal ones rarely a little recurved in age; *petals* ochroleucous with faintly maculate keel-tip, exceptionally pink-tinged; *banner* recurved through 45° (often further in withering), 15–23.5 mm. long, the broad claw expanded into an oval or rhombic-ovate, notched, somewhat fleshy blade 7.8–12 mm. wide; *wings* 15–22 mm. long, the claws 5.3–8.4 mm., the narrowly oblong-oblanceolate, little incurved, obtuse but often obscurely erose-emarginate blades 10–15.7 mm. long, 2.5–4.5 (5) mm. wide; *keel* 11.5–17 mm. long, the claws 5.1–8.6 mm., the half-obovate blades 6.8–9 (10) mm. long, 3.6–4.7 mm. wide, abruptly incurved through 90–105° to the bluntly rectangular apex; *anthers* (0.7) 0.8–1 (1.2) mm. long; *pod* erect, horizontally spreading, or more rarely declined, sessile, subsessile, or stipitate, the turgid or decidedly inflated (but never bladdery) body varying from narrowly ellipsoid to broadly ovoid, obovoid, or subglobose, 1.8–3.8 (4.2) cm. long, 0.5–1.5 cm. in diameter, cuspidate at apex, straight or a little incurved, subterete or somewhat dorsiventrally compressed, carinate ventrally by the very thick, prominent suture, rounded or shallowly sulcate dorsally, the thickly fleshy, green or purplish-speckled valves becoming stiffly leathery or subligneous, rugulose and brown or stramineous, pulpy-filamentous within, externally glabrous, minutely scaly-puberulent, or strigulose with white hairs up to 0.05–0.3 mm. long, inflexed as a narrow partial septum 0.8–2.3 mm. wide; *ovules* (40) 44–75 (84); *seeds* brown, sometimes purple-speckled, smooth but dull, 3–3.8 mm. long.

The stinking milk-vetch, *A. praelongus,* is a coarse, rather handsome astragalus, distinguished from all but its close relative *A. Pattersoni* (keyed above) by its truly or apparently hairless foliage of thick texture, dense racemes of rather large, nodding, ochroleucous flowers, basally pouched calyx of the same color as the petals, and large, internally pulpy, partially bilocular pods. The freshly gathered herbage gives forth a strong (to some people nauseating) smell of selenium, which seems to gather strength during the long process of drying out herbarium specimens. The plants are highly toxic but are seldom browsed by healthy animals, and then only as a last resource, even though, being remarkably drought-resistant, they form tufts of apparently appetizing greenery in a landscape turned brown and sere from lack of rain. The forming fruits are commonly infested with maggots, so that despite the large number of ovules, comparatively few ripen into viable seeds. The species, nevertheless, is a vigorous and successful one, flourishing in areas subject to rapid erosion and hostile to much plant life. The typical form of *A. praelongus* is reportedly used by the Hopi Indians, under the name of sisikinga, in treatment of bladder troubles.

The foregoing description of *A. praelongus* acknowledges a relatively enormous range of variation in stature of the plants, in width and outline of the leaflets, in length of the calyx-teeth, and (to less degree) in length of the petals, but the various types of variation are only feebly correlated among themselves and hardly at all with rational patterns of dispersal. This general statement must be modified to the extent that the tallest stems, the widest (often emarginate) leaflets, and the shortest calyx-teeth are found most frequently, though only rarely all together, toward the west edge of the species-range. Variation in the pod is very marked and has been the basis for the elaborate segregation of minor variants in the rank of species. The largest pods, of thickest texture, commonly truncate or nearly so at base, are found chiefly in Arizona's northern tier of counties and in the Muddy and Virgin Valleys in southwestern Utah and southern Nevada. Such fruits may be either glabrous or puberulent;

when exceptionally thick-walled and succulent, they tend to spread horizontally from the raceme-axis or eventually nod, apparently of their own weight. A fruit of this type characterized the original *A. praelongus* and the negligible *Jonesiella Mearnsii.* Passing eastward toward the watershed of the Little Colorado and across northwestern New Mexico to the upper San Juan and just across the Continental Divide to the west affluents of the Rio Grande, one notices a gradual transition into an erect or ascending pod commonly a little shorter and smaller, varying in outline from ovoid *(A. Rothrockii)* to obovoid *(Jonesiella recedens),* or globose. A pod of the smaller type is more often broadly turbinate than truncate at base, and ordinarily of slightly thinner texture. In the Colorado Basin north of the San Juan River, the prevailing form of the pod is narrowly ellipsoid, narrowly oblong, or clavately ellipsoid. In this region it is nearly always erect or ascending and puberulent, either when young or permanently, but it varies from straight to gently incurved and from subterete to distinctly obcompressed and shallowly sulcate dorsally. Along the lower Gunnison River the pod shades gradually from oblanceolate to clavate and ultimately obovate in profile, thus passing insensibly into the state described above as corresponding with *Jonesiella recedens.* In the Rio Grande Valley from Santa Fe southward and east to the head of the Canadian and the Staked Plains, the pod of *A. praelongus* again assumes a narrow outline and appears wholly similar to that of the Utah plants, except that it is more often glabrous and sometimes more deeply grooved dorsally. The typus of *Jonesiella Ellisiae* represents this form. It cannot be overemphasized that the transition from a narrow pod to a broad one is extremely gradual and fully documented by an uninterrupted series of minor variants. Nevertheless the extreme forms are strikingly unlike; and since relatively plump or slender pods are found exclusively over extensive areas, it becomes reasonable to maintain two intergradient varieties, var. *praelongus* and var. *Ellisiae.* About nine-tenths of the material I have examined can be referred to one of these categories on a basis of a pod more or less than one centimeter in diameter. In one out of ten colonies the pods vary around a mean diameter of approximately one centimeter, and these cannot be identified except perhaps on a statistical basis.

The discussion up to this point applies only to those forms of *A. praelongus* in which the pod is sessile or nearly so, with a stipe, if at all differentiated from the body, not over thrice as long as its diameter and not over 2.5 mm. long. In a restricted area in northeastern Arizona and adjoining states, the stinking milk-vetch is represented by a form bearing a pod as narrow as that of var. *Ellisiae* but elevated on a stipe as long or slightly longer than the calyx-tube. It is treated below as *A. praelongus* var. *lonchopus.*

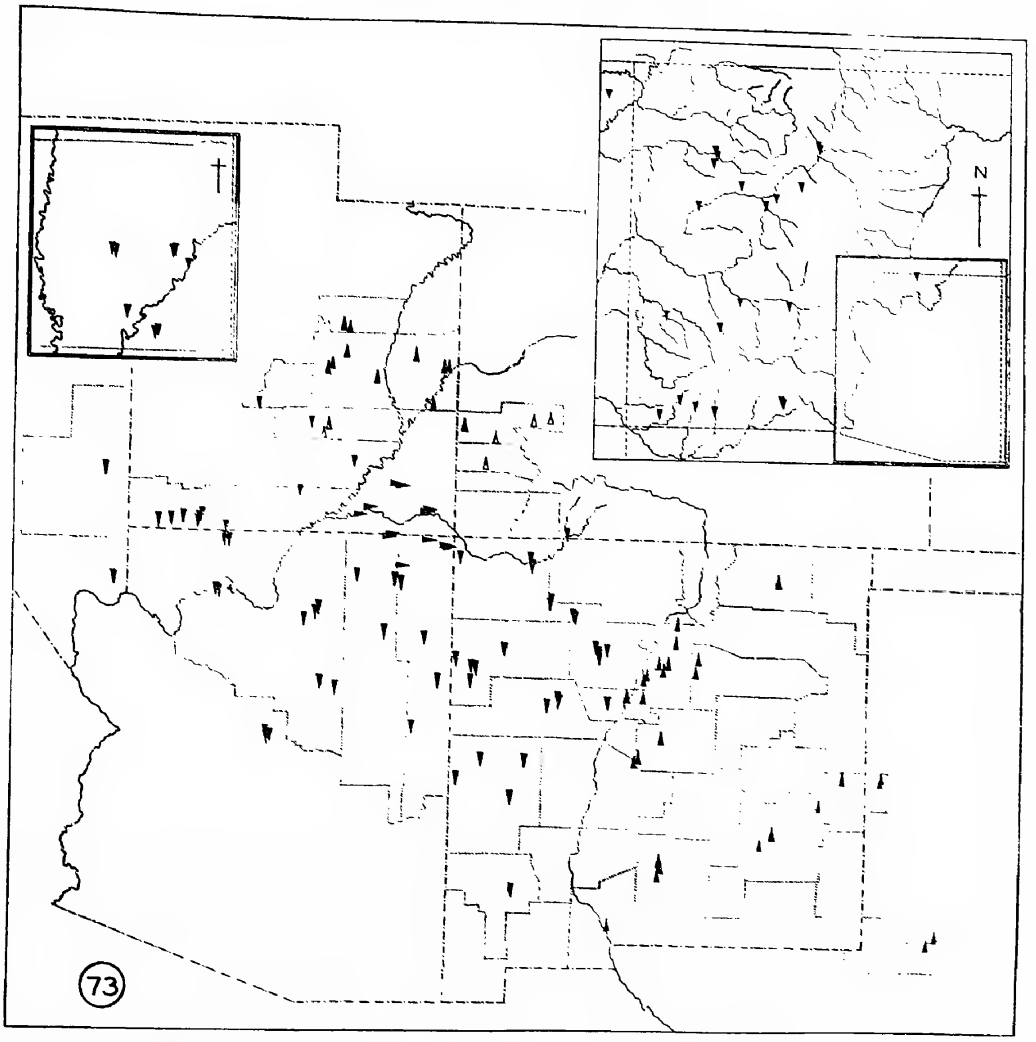
Key to the Varieties of A. praelongus

1. Pod sessile or shortly stipitate, the stipe not over thrice as long as its diameter nor over 2.5 mm. long; widespread (2)
   2. Body of the pod broadly and plumply oblong, ovate-oblong, obovate, or ovate-elliptic in dorsiventral view, (9) 10–15 mm. in diameter; s. Nevada and s.-w. Utah, e. across n. Arizona to s.-w. Colorado and to New Mexico w. of the Rio Grande ..... 184a. var. *praelongus*
   2. Body of the pod narrowly elliptic, oblong-elliptic, or clavately oblanceolate in dorsiventral view, 6–10 (11) mm. in diameter; bicentric in distribution: Colorado Basin in e.-centr. Utah and s.-w. Colorado; Rio Grande Valley in New Mexico, e. to n.-e. New Mexico and w. Texas ..... 184b. var. *Ellisiae*
1. Pod long-stipitate, the stipe 4.5–8 mm. long; local in extreme n.-e. Arizona and adjoining Utah and Colorado ..... 184c. var. *lonchopus*

184a. Astragalus praelongus var. praelongus

Calyx-teeth variable in length, deltoid to lance-subulate, 0.3–4.7 mm. long; *pod* 2–3.8 (4.2) cm. long, (9) 10–15 mm. in diameter, either sessile or abruptly contracted at base into an obconic stipe or stipelike neck up to 2.5 mm. long, either truncate or rounded, or broadly turbinate at base, broadest below, at, or above the middle, subsymmetric or decidly asymmetric in profile, if the latter then the dorsal suture the more strongly convex, the valves either glabrous or puberulent.—Collections: 64 (xiii); representative: *F. W. Gould 1617* (CAS, NY, WS); *M. Ownbey 3011* (CAS, NY, RSA, WS); *Barneby 12,656* (CAS, NY, RSA), *12,980* (RSA); *Ripley & Barneby 7570* (CAS, RSA), *8364* (RSA); *Castetter & Dittmer 6022* (herb. Univ. New Mex.).

Gullied bluffs, sandstone escarpments, clay knolls, and sandy or sandy clay plains and bottomlands, in selenium-rich soils derived from sandstone, shale, or



Map No. 73. Bottom, Arizona, New Mexico, and parts of adjoining states. Range of *A. praelongus*: ◆ var. *praelongus*; ▲ var. *Ellisiae* (△ populations intermediate to var. *praelongus*); and ◗ var. *lonchopus*. Top right, Colorado (with Arizona inset). Range of *A. Pattersoni*. Top left, Grand County, Utah. Range of *A. sabulosus*.

more rarely limestone or volcanic tuff, 2750–7100 feet, widespread and locally common from the Muddy and Virgin Valleys in southeastern Nevada and southwestern Utah, south to the Grand Canyon and the upper Verde Valley in Arizona, thence east across Arizona north of the Mogollon Escarpment to the headwaters of the San Juan River in southwestern Colorado, and south in New Mexico west of the Rio Grande to the head of the Gila River in Grant County.—Map No. 73.—April to July, the fruit often persisting over winter on withered stems.

ASTRAGALUS PRAELONGUS (very tall) Sheld. in Minn. Bot. Stud. 1: 23. 1894, a legitimate substitute for *A. procerus* (tall) Gray in Proc. Amer. Acad. 13: 369. 1878 (non *A. procerus* Bss. & Hsskn., 1872).—"Near St. Thomas, S. E. Nevada, at the confluence of the Muddy River with the Virgen, Dr. Palmer, 1877."—Holotypus, *Palmer 112 in 1877*, GH! isotypi, K, NY, P, US!—*A. Pattersoni* var. *procerus* (Gray) Jones in Proc. Calif. Acad. Sci. II, 5: 636. 1895. *A. Pattersoni* var. *praelongus* (Sheld.) Jones, Contrib. West. Bot. 10: 65. 1902. *Phacopsis praelongus* (Sheld.) Rydb. in Bull. Torr. Club 32: 661. 1905. *Rydbergiella praelonga* (Sheld.) Fedde & Sydow in Bot. Jahresb. 33[1]: 534. 1905. *Jonesiella praelonga* (Sheld.) Rydb. in N. Amer. Fl. 24: 404. 1929.

Astragalus Rothrockii (Joseph Trimble Rothrock, 1839–1922, surgeon and botanist with Lieut. Wheeler's Expedition, 1873–5) Sheld. in Minn. Bot. Stud. 1: 175. 1894.—"Collected in New Mexico, 1877, by Professor J. T. Rothrock; also at Wabash Ranch, eastern Arizona, July, 1892, by Professor E. O. Wooton."—Holotypus, collected by Rothrock in 1879, MINN!—*Jonesiella Rothrockii* (Sheld.) Rydb. in N. Amer. Fl. 24: 404. 1929.

Jonesiella recedens (standing back from, hence different) Rydb. in N. Amer. Fl. 24: 403. 1929.—"Type collected at Arboles, Colorado, June 1899, *Baker 432* . . . "—Holotypus, collected by C. F. Baker, *No. 422* (!), NY! isotypi, GH, K, MO, ND!—*Astragalus recedens* (Rydb.) C. L. Porter in Univ. Wyo. Pub. 16: 19. 1951.

Jonesiella Mearnsii (Edgar Alexander Mearns, 1856–1916) Rydb. in N. Amer. Fl. 24: 403. 1929.—"Type collected at Fort Verde, Arizona, in May 1887, *Edgar A. Mearns 163* . . . "—Holotypus, NY!

The principal types of variation I have observed in the flowers and fruits of the stinking milk-vetch, var. *praelongus,* have been discussed in an introductory note to the species and are implicit in the description and synonymy. A minor variant associated with normal plants on the badlands of the Virgin Valley in Washington County, Utah, has pinkish-lavender flowers.

184b. Astragalus praelongus var. Ellisiae

Calyx-teeth subulate or lance-attenuate, 2–5.5 mm. long; *stipe* of the pod 1–2.5 mm. long, the *body* ellipsoid, oblong-ellipsoid, or narrowly clavate-ellipsoid, straight or gently incurved, 1.8–3.4 cm. long, (5) 6–10 (11) mm. in diameter, rounded or shallowly sulcate dorsally, either strigulose, or puberulent along the sutures, or glabrous.—Collections: 47 (x); representative: *Ripley & Barneby 4700, 4730, 5421, 5399* (all RSA); *Jones* (from Price, Utah) *in 1896* (CAS, NY, POM); *Eggleston 20,063* (NY); *A. A. & E. G. Heller 3668* (ND, NY); *Barneby 12,608* (CAS, RSA); *Warnock 8392* (SMU, SRSC, TEX).

Habitats of var. *praelongus,* 2800–6500 (6900) feet, of bicentric distribution: locally abundant in the Colorado Basin of Utah and Colorado south of Tavaputs Escarpment, there sometimes (cf. map) intergrading with var. *praelongus;* again locally plentiful along the east side of the Rio Grande Valley in New Mexico, from Santa Fe County south to Mesilla Valley, east in scattered stations to the head of the Canadian River, the Pecos Valley, and just into extreme western Texas (Bailey, Martin, and Midland Counties).—Map No. 73.—April to July.

Astragalus praelongus var. Ellisiae (Rydb.) Barneby ap. B. L. Turner, Legum. Tex. 190. 1959, based on *Jonesiella Ellisiae* (Charlotte Cortland Ellis, 1874– , nurse and plant collector) Rydb. in N. Amer. Fl. 24: 403. 1929.—"Type collected in the Sandia Mountains, New Mexico, April 30, 1914, *Charlotte C. Ellis 421* . . . "—Holotypus, US! isotypi, MO, NY!—*Astragalus Ellisiae* (Rydb.) C. L. Porter ex Beath & al. in Amer. Jour. Bot. 28: 888. 1941.

At anthesis var. *Ellisiae* is indistinguishable from var. *praelongus.* The narrow fruit is the only practical differential character, and as I have already indicated, there are many instances of intergradation even in this feature. The following collections demonstrate the confluence of the two varieties: *W. A. Weber 4743* (CAS, OKLA, SMU, TEX, WS); *C. F. Baker 278* (ND, NY); *Payson 352* (WS). The holotypus of *Jonesiella recedens* might be added to this list, but the pod (as in all isotypi examined) is unripe and its ultimate diameter unknown. Since it seems reasonable to assume that it represents the same entity as that found downstream along the San Juan around Aztec and Bloomfield, the species has been referred to the synonymy of var. *praelongus.* The bicentric dispersal of var. *Ellisiae* is unusual in the genus and leads one to suspect that the variety, as defined in these pages, embraces two independent but parallel evolutionary lines divergent from var. *praelongus.* In support of this view I must add that the modes of variation are not identical in the two lobes of the variety's range. In the Colorado Basin the pod is more often pubescent than glabrous, and it tends to spread from the raceme-axis at variable but sometimes wide angles. In the southeastern area the pod is most commonly erect and glabrous, and more often sulcate dorsally than terete. However, since it is possible to select identical pods from each area, no practical method has been found to distinguish the individual members of what seem to be incipient geographic varieties.

The type-locality of *J. Ellisiae* is actually on the northwest slope of the Sandia Moun-

tains near Tijeras, Bernalillo County. The variety was apparently first collected near Albuquerque in 1846 by Dr. Wislizenus (MO).

184c. Astragalus praelongus var. lonchopus

Calyx-teeth 3–6.5 mm. long, subulate or subulate-attenuate; *pod* erect or more rarely spreading, wholly similar to that of var. *Ellisiae* except for the long stipe (4.5–8 mm. long), the body 2–3 cm. long, 7–9 mm. in diameter, rounded or shallowly sulcate dorsally, the valves commonly minutely puberulent.—Collections: 16 (ii); representative: *Rydberg & Garrett 9913* (NY); *Cutler 2292* (CAS, MO, NY, WIS); *Peebles & Smith 13,553* (ARIZ, NY, POM), *13,588* (ARIZ, CAS); *Barneby 12,780a* (CAS, NY, RSA), *13,080* (BRY, CAS, NY, RSA); *Brandegee 4323* (MO).

Habitats of var. *praelongus,* apparently confined to sandstone, 3700–5400 feet, locally plentiful in the canyons of the San Juan and Colorado Rivers in extreme northern Apache and Navajo Counties, Arizona, San Juan County, Utah, and southwestern (probably Montezuma County), Colorado, to be expected in northeastern San Juan County, New Mexico.—Map No. 73.—Late April to July, the pods often persisting over winter on withered stems.

Astragalus praelongus var. lonchopus (with long stipe) Barneby in Leafl. West. Bot. 9: 90. 1960.—"Arizona: Rattlesnake Mines, Carrizo Mountains, Apache County, Arizona, the collector not recorded, distributed as *U. S. Geological Survey No. 511.*"—Holotypus, CAS!

Jonesiella arcta sensu Rydb. in N. Amer. Fl. 24: 402. 1929, exclus. basionym.

The var. *lonchopus* is distinguished consistently from other forms of its species by the long stipe alone, but the plants are often remarkable for their long calyx-teeth and a tendency toward narrow and subacute leaflets matched only rarely in var. *praelongus.* Its known range extends from the Four Corners country westward for about one hundred miles and north to the Natural Bridges in White Canyon; in this area it is apparently the only stinking milk-vetch, occurring in the same habitats as var. *praelongus* and var. *Ellisiae,* but sympatric with neither. The substance of the variety has been known for many years, for it is probably (at least in great part) the *Rydbergiella arcta* sensu Rydberg (1917, p. 501) and the *Astragalus arctus* sensu Tidestrom (1925, p. 327), as well as the *Jonesiella arcta* cited in synonymy above. These three names go back through the illegitimate *A. Preussii* var. *arctus* Sheld. to *A. Preussii* var. *latus* Jones, a minor variant of genuine *A. Preussii.* The pods of var. *Preussii* and *A. praelongus* are similar in orientation, shape, and stipe, but that of the Preuss milk-vetch is of papery texture, truly unilocular, and devoid of pulpy filaments in the cavity. The two species grow close together in southeastern Utah but are easily distinguished both by the fruits and by the entirely different flowers (cf. key to the subsections of sect. *Preussiani*).

185 Astragalus Pattersoni

Similar in growth-habit to *A. praelongus,* usually robust, with several or many erect and ascending stems forming well-furnished clumps, the stems glabrous below the middle, often thinly strigulous distally, the thick-textured herbage green or sometimes pallid-glaucescent, the leaflets (at least some upper leaves) thinly strigulose beneath with fine, straight, appressed hairs up to 0.2–0.5 mm. long, the inflorescence usually black-strigulose; *stems* 2–5 dm. long, usually tinged with red (drying reddish- or purplish-brown), rarely green, simple or shortly spurred at some lower or median axils, often flexuous or zigzag distally; *stipules* 3–8 mm. long, all firm, purplish, becoming papery and brownish, or the upper ones (occasionally all) pallid and membranous, all ± amplexicaul-decurrent, the lowest around ¾ to the whole stem's circumference, sometimes obscurely united, the upper ones triangular-lanceolate, semiamplexicaul; *leaves* 5–13 cm. long, shortly petioled or the uppermost subsessile, with (9) 15–25 (29) commonly oblong-elliptic leaflets 5–30 mm. long, those of the upper leaves varying from obtuse to sharply acute, nearly always narrower than the retuse to obtuse, sometimes mucronulate ones of the lower leaves; *peduncles* erect, usually stout, (3) 5–14 cm.

long; *racemes* 10–25-flowered, rather dense at early anthesis, the flowers nodding and ± retrorsely imbricated, the axis soon elongating, 3–15 cm. long in fruit; *bracts* membranous, lanceolate or lance-acuminate, 2–8 mm. long; *pedicels* at anthesis 1–1.5 mm. long, in fruit ascending, straight, 1.7–4 (4.5) mm. long; *bracteoles* 2, commonly conspicuous; *calyx* (8.8) 10.5–14.2 mm. long, white or red-tinged, thinly white- or black-strigulose, the oblique disc 0.9–1.5 mm. deep, the membranous, deeply campanulate or cylindric, nearly always basally pouched tube (6) 6.5–8.8 mm. long, 3.5–4.8 mm. in diameter, the narrowly lance-acuminate or subulate-setaceous, spreading or loosely recurving teeth (2.3) 3–6.8 mm. long; *petals* white, the keel-tip faintly maculate; *banner* recurved through 50–90°, 14.6–21.5 mm. long, the long-cuneate claw expanded into an oval or ovate, truncate, mucronulate, erose-emarginate, or very shallowly retuse blade 6–10 mm. wide; *wings* 14.8–20 mm. long, the claws 7.2–9.1 mm., the oblong-oblanceolate or -lanceolate, rarely elliptic or narrowly ovate, obtuse or subacute blades 8.4–12.2 mm. long, 2.7–4 mm. wide; *keel* 12.4–15 mm. long, the claws 7–9 mm., the lunately half-elliptic blades 5.7–7.5 mm. long, 2.5–3.5 (3.8) mm. wide; *anthers* 0.7–0.85 mm. long; *pod* strictly erect, sessile, oblong-ellipsoid, lance-ellipsoid, or narrowly ovoid, (1.7) 2–3.5 (3.8) cm. long, 6–10 mm. in diameter, rounded or cuneate at base, abruptly contracted distally into a rigid, cuspidate beak, straight or commonly a little incurved, nearly terete to strongly obcompressed at maturity, the thick, salient ventral suture either convexly or (in the lower ½–⅔) concavely arcuate (then depressed and lying in a double groove), the succulent, green or reddish-green, glabrous or rarely puberulent valves becoming stiffly leathery, brown or stramineous, rugulose-reticulate, inflexed as a sometimes obscure septum 0.3–1.4 mm. wide; *ovules* 22–38; seeds smooth, pale or greenish-brown, ± 3–3.5 mm. long.—Collections: 31 (xii); representative: *Osterhout 2114* (NY, RM, WIS); *W. A. Weber 3354* (CAS, RSA, TEX, WS), *4911* (CAS, SMU, TEX, WS); *Killip 36,493* (RSA, US); *Ripley & Barneby 10,266* (CAS, RSA), *10,515* (CAS, NY, RSA); *Barneby 13,162* (CAS, NY, RSA).

Open banks, gullied hillsides, barren knolls, and over-grazed pastures, usually in stiff adobe or gumbo soils, (5400) 6000–8250 feet, rather frequent and locally plentiful in the oak-brush belt along the west slope of the Colorado Rocky Mountains, from the upper White and Grand Rivers south to the upper tributaries of the San Juan, west to the south slope of the Uintah Mountains in northern Uintah County, Utah; also disjunctly on red clay hills, ± 4900 feet, in the valley of Kanab Creek at the north edge of Coconino County, Arizona.—Map No. 73.—May to July, the dead fruits often persistent over winter.

ASTRAGALUS PATTERSONI (Henry Norton Patterson, 1853–1919, of Oquawka, Illinois, newspaper printer and plant collector) Gray ex Brand. in Bull. U. S. Geol. Surv. 2^8: 235. 1876. —"The only flowering specimens were collected by Mr. H. N. Patterson . . . in the foothills of the Gore Mountains, Colorado . . . "—Holotypus, collected by Patterson on July 28, 1876, on the Harris & Co. Ranch in the foothills of the Gore Mountains, Middle Park, near the Grand Canyon of Grand River, GH! isotypi, ND, NY, PH, US!—*Tragacantha Pattersoni* (Gray) O. Kze., Rev. Gen. 947. 1891. *Phacopsis Pattersoni* (Gray) Rydb. in Bull. Torr. Club 32: 661. 1905. *Rydbergiella Pattersoni* (Gray) Fedde & Sydow in Bot. Jahresb. 33^1: 534. 1905 (*"Pattersonii"*). *Jonesiella Pattersoni* (Gray) Rydb. in N. Amer. Fl. 24: 402. 1929.

The Patterson milk-vetch is closely related to *A. praelongus* and the two species have often been confounded. Even in the first instance Gray's description of the pod was based partly on material of *A. praelongus* collected by Ward in Utah. The attention of botanists has been focused so intently on the fruit, to the exclusion of valuable characters in the flowers, that the apparent or claimed differences between the two have become increasingly nebulous. The pod of *A. Pattersoni* is quite variable in length, shape, and maximum diameter, sometimes in one colony of plants, and no single feature of the fruit's form provides a satisfactory differential character. However, sharply defined discontinuities in ovule-number, in form of the calyx, in

flower-color, and in shape of the keel-petals effectively separate *A. Pattersoni* from *A. praelongus,* all forms of which have essentially the same flower but extremely variable pods. While *A. praelongus* is a plant of desert and semidesert environments, climbing to 7100 feet only on the arid crest of the Continental Divide in northwestern New Mexico, *A. Pattersoni* is characteristic of middle elevations in the Rocky Mountains, in the relatively well-watered oak belt between 6000 and 8000 feet. The disjunct occurrence of an extensive and vigorous population of the Patterson milk-vetch on the badlands of Kanab Creek in Arizona (near Fredonia, *Ripley & Barneby 4361,* CAS, RSA), over two hundred miles west of the main range, can be explained rationally only by assuming the species to be introduced in this locality. Typical *A. praelongus* is found in quantity on the same ridge, apparently in identical environment, although the two species are not directly associated or intermingled.

The Patterson milk-vetch is ordinarily recognized in the field by its shining red (rarely green) stems which form a handsome contrast with the green or glaucescent foliage and snow-white flowers. Calyx and petals are usually of the same clear white, but the former is sometimes tinged with red and the keel-tip is faintly lavender-tipped. The calyx-teeth are commonly crowded toward the dorsal side of the tube and more or less stellately recurved or distally hooked. The Patterson milk-vetch is as ill-scented and as poisonous as the commoner *A. praelongus,* but is found in a region where palatable forage is more easily available to stock. The plants are often trampled by cattle, but are seldom browsed.

LI (iii). Subsectio Sabulosi

Low, but coarse and robust; *leaflets* few, mostly 3–11, large; *racemes* shortly few-flowered, the large, yellowish flowers ascending at anthesis; *calyx-tube* broadly cylindric, 11.5–14 mm. long; *banner* ± 3 cm. long; *pod* pendulous, subsessile, oblong-ellipsoid, turgid or inflated but scarely bladdery, the valves becoming stiffly papery, naked or sparsely filamentous within, inflexed as a very narrow partial septum; *ovules* 48–54.—Sp. 1, of desert badlands in the lower Grand River Valley, eastcentral Utah.

Astragalus sect. Preussiani subsect. Sabulosi, subsect. nov., a *Preussianis* veris floribus permagnis flavis, a subsect. *Pattersonianis* floribus adscendentibus (nec nutantibus), calyce basi haud gibbo, legumine chartaceo, foliolisque paucis magnis, praeterea ab omnibus habitu singulari proprio absimiles.—Sp. unica: *A. sabulosus* Jones.

186. Astragalus sabulosus

Robust, diffuse, perennial but apparently of rapid growth and short duration, strigulose with appressed, flattened, scalelike or filamentous, or with largely longer, subfiliform hairs up to 0.35–1 mm. long, the vesture variable in density and dispersal, the lower leaves often glabrous and the upper ones pubescent, or all pubescent, the herbage varying from green to silvery-silky, and the leaflets from glabrous to silky above; *stems* several, decumbent and incurved-ascending, 1–2.8 dm. long, simple or spurred below the first peduncle, usually striate, hollow, and (2.5) 4–8 mm. in diameter near the base; *stipules* 4–9 mm. long, broadly ovate, ovate-acuminate, or triangular-attenuate, decurrent around ± half the stem's circumference, the lowest (sometimes all) glabrous dorsally, the blades nearly always reflexed; *leaves* (3) 5–10 cm. long, shortly petioled, with 5–11 (or in some early leaves only 3 or 1) broadly rhombic-oval, -obovate, or elliptic, or (when very large) somewhat flabellate, abruptly mucronate-acuminate, flat leaflets 1–4 (5) cm. long, the largest of them pinnately veined; *peduncles* stout, incurved, 3.5–7 (8) cm. long, shorter than the leaf; *racemes* loosely but shortly 6–10-flowered, the flowers loosely ascending, the axis scarcely elongating, 1–2 cm. long in fruit; *bracts* membranous, lanceolate or lance-acuminate, 2.5–6 mm. long; *pedicels* at anthesis ascending, 2–3 mm. long, in fruit thickened, arcuate-recurved, 3–5 mm. long; *bracteoles* commonly 2, sometimes 0; *calyx* 15–17.5 mm. long, densely and loosely strigulose with black or fuscous hairs, the somewhat oblique disc 2.6–3 mm. deep, the broadly cylindric or subcylindric, somewhat tumid tube 11.5–14 mm. long, 5.5–7.3 mm. in diameter, the triangular or triangular-subulate teeth

3.5–4 mm. long, the whole becoming papery, ruptured, marcescent; *petals* dull straw-yellow; *banner* recurved through ± 40°, broadly oblanceolate or obovate-cuneate, notched, 28.5–31 mm. long, 10.6–14 mm. wide; *wings* 25.5–28 mm. long, the claws ± 13 mm., the narrowly oblong or lance-oblong, obtuse, truncate, or obscurely emarginate, straight blades 14.5–16.5 mm. long, 3.8–4.5 mm. wide; *keel* 22–23 mm. long, the claws 13.2–13.5 mm., the subsymmetrically elliptic, or half-obovate blades 10–10.5 mm. long, 3.7–4.7 mm. wide, incurved through 30–80° to the blunt apex; *anthers* 0.8–1 mm. long; *pod* pendulous, subsessile, contracted at base into a thick, stipelike neck 1–1.5 mm. long, the ± inflated body broadly oblong-ellipsoid, ellipsoid, or broadest above the middle and clavately oblong-ellipsoid, (2) 2.5–4.5 cm. long, 1–1.5 cm. in diameter, straight or a trifle incurved, abruptly contracted distally into a short, triangular beak, scarcely compressed but openly and shallowly sulcate along both sutures, the thinly fleshy, green, strigulose valves becoming stiffly papery, pallid stramineous or brownish, cross-reticulate, inflexed as a very narrow partial septum 0.5–1 mm. wide; *dehiscence* apical, through the gaping beak, and tardily basal, through the ventral suture; *seeds* mahogany-brown, either smooth and lustrous or dull and sparsely pitted, more rarely ochraceous and dull, 2.8–4.2 (4.7) mm. long.—Collections: 12 (ii); representative: *Jones* (from near Moab) *in 1913* (POM, NY, US, WS), and (from La Sal Mountains) *in 1913* (CAS, NY, POM, US, WS, WTU); *Rydberg & Garrett 9089* (NY); *C. L. Porter 2840* (WS, WTU); *Ripley & Barneby 9212* (CAS, RM, RSA, UTC).

Along washes and at the edge of gullies in low, barren hills, in stiff clays and alluvial gravels derived from selenium-bearing sandstones, 4100–5200 feet, local but forming colonies, known only from three restricted areas (around Cisco; between Cisco and Thompson Springs; vicinity of Moab) in the deserts of the lower Grand River Valley, between the Roan Cliffs to the north and the La Sal Mountains to the south, in Grand County, Utah.—Map No. 73.—April to June, the flowers early fading.

ASTRAGALUS SABULOSUS (of coarse sands or gravels) Jones in Zoë 2: 239. 1891.—"Collected May 2, 1890, at Cisco, Utah, on gravelly soil near Grand River."—Holotypus (3 sheets, some labeled "Clay slopes on banks of Grand River," one "Cisco, on road to Moab"), POM! —*Jonesiella sabulosa* (Jones) Rydb. in N. Amer. Fl. 24: 402. 1929.

The Cisco milk-vetch, *A. sabulosus,* is next to *A. asclepiadoides* the most peculiar and easily recognized astragalus native to badlands on the Colorado Basin floor. It is remarkable for its few, large leaflets which tend to be diamond-shaped and pointed at apex, for the few, very large flowers with their baggy, dark villosulous calyx and pale yellow petals, and for the drooping, decidedly inflated, but firmly chartaceous and so hardly bladdery pod. The pubescence of *A. sabulosus* is also characteristic. In the first place the hairs are largely flattened and scalelike, although longer, filiform trichomes are also commonly present. As a rule, the leaves low on the stems are green and only thinly strigulose; those borne at axils above the inflorescences are gray or even silvery-silky. The Cisco milk-vetch flowers very early in the year, and too few plants have been collected at anthesis to establish the full range of size-variation in the flower. According to Jones the pod may reach a length of 5 cm., but I have seen none over 4.5 cm. long. As compared with the related *Pattersoniani, A. sabulosus* has not only much fewer and much larger flowers but shorter, decumbent stems, fewer and larger leaflets, and decurved pods of thinner texture.

LII. Sectio NEGLECTI

Tall, caulescent perennials with taproot and knotty root-crown at or just below soil-level; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with 11–25 thin-textured leaflets; *flowers* shortly racemose, nodding, of moderate size, the banner 11.5–16 mm. long; *pedicels* thickened-persistent; *calyx-tube* campanulate; *petals*

white or ochroleucous, regularly but only slightly graduated, the keel-tip obtuse; *pod* erect, sessile, persistent, obliquely ovoid or ovoid-ellipsoid, greatly inflated, the stiffly papery valves not or narrowly inflexed; *dehiscence* apical, through the gaping beak; *ovules* 12–20.—Sp. 1, mesophyte, of streamsides and lake shores in the Great Lakes region, northcentral United States and adjoining Canada.

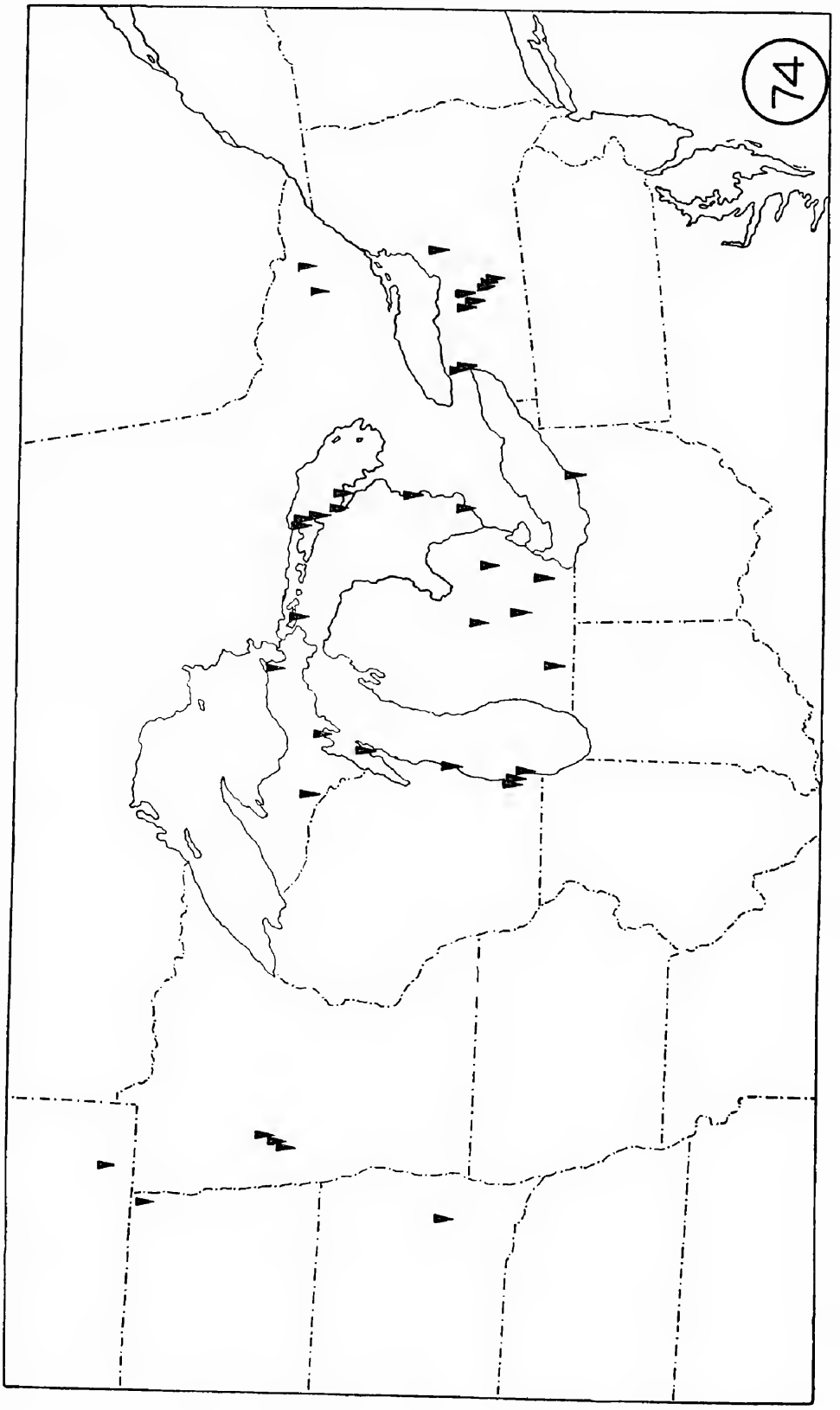
ASTRAGALUS sect. NEGLECTI (Rydb.), comb. nov., based on *Phaca* subgen. *Dermatocystis* sect. *Neglectae* Rydb. in N. Amer. Fl. 24: 364. 1929.—Sp. unica: *P. neglecta* T. & G. = *A. neglectus* (T. & G.) Sheld.

Astragalus ser. *Phaca* sect. *Araneocarpus* Sheld. in Minn. Bot. Stud. 1: 141. 1894, pro parte, sine descr.—Sp. typica (by inference, from the epithet): *A. neglectus* (T. & G.) Sheld.

Since the affinities of sect. *Neglecti* are unknown, its position next following the *Preussiani* is purely arbitrary. Gray (1864, p. 213) associated *A. neglectus* with *A. oocarpus* in a group (sect. *Oocarpi*) composed of just these two species which have, by coincidence, many common technical characters such as free stipules and an erect, persistent, inflated pod of stiffly papery texture. The typus of sect. *Oocarpi*, *A. oocarpus*, is a xerophytic species endemic to a small area in cismontane southern California, almost certainly derived by specialization from the sympatric piptoloboid *A. Douglasii* or from some immediate ancestor common to both. By contrast *A. neglectus* is a denizen of moist or at least cold soils about the Great Lakes, and differs greatly in appearance by reason of its shortly racemose, nodding, differently proportioned flowers, while the pod is often narrowly septiferous and the ovules notably few in proportion to the fruit's size. Gray emphasized the filaments or "cobwebby hairs," which traverse the cavity of the pod, but these are not unusually many or conspicuous for a pod of like texture. The epithet *Araneocarpus* Sheld. applied to a later section incorporating *A. neglectus* and *A. giganteus* was no doubt suggested by Gray's observation. This even more unnatural section, which coupled *A. neglectus* with a species quite as remote in morphology and dispersal as *A. oocarpus*, was fortunately undescribed, so that I feel justified in taking up in *Astragalus* Rydberg's monotypic *Phaca* sect. *Neglectae*. Jones transferred *A. neglectus* to sect. *Uliginosi* next to *A. canadensis*. The two species are somewhat similar superficially and sometimes occur in the same habitats, but the *Uliginosi* differ in their stoloniferous habit of growth, dolabriform vesture, and connate stipules, in addition to important differences in the flower. Apparently *A. neglectus* has no close surviving relative.

187. ASTRAGALUS NEGLECTUS

Commonly robust, the stems glabrous or nearly so, the herbage green, the leaflets glabrous above, thinly pubescent beneath with straight and appressed or narrowly ascending hairs up to 0.3–0.7 mm. long; *stems* several, mostly stiffly erect and 5–9 dm. long, more rarely slender, ascending and only 2.5–3 dm. long, leafless at base, stramineous, striate, hollow, branched or spurred at 1–several nodes preceding the first peduncle, floriferous upward from near or commonly from well above the middle; *stipules* membranous or thinly herbaceous, (1.5) 2–6 mm. long, the lowest broadly ovate, several-nerved, becoming fragile and often irregularly deciduous by late anthesis, semiamplexicaul, the median and upper ones progressively narrower, triangular or lanceolate, glabrous dorsally, thinly ciliate, commonly deflexed; *leaves* 4–12 cm. long, shortly petioled or the uppermost subsessile, with 11–23 (25) oblong-elliptic, oblong, or oblong-obovate (rarely in some upper leaves, linear-oblong), obtuse or retuse-emarginate, flat leaflets (4) 7–27 (30) mm. long; *peduncles* rather stiffly erect, (2.5) 3–7.5 cm. long, shorter than the leaf; *racemes* shortly but loosely (6) 10–20-flowered, the flowers nodding at full anthesis, the axis a little elongating, 1–4.5 cm. long in fruit; *bracts* membranous becoming papery and fragile, triangular-lanceolate, 1–2.2 mm. long; *pedicels* at anthesis ascending and arched outward, 1–2 mm. long, in fruit erect, thickened, 2–5 mm. long; *bracteoles* 0–2; *calyx* 5.6–8 mm. long, strigulose with black, fuscous, and often some intermingled (rarely all) white hairs, the oblique disc 0.6–1.5 mm. deep, the campanulate tube 3.7–5 mm. long, 2.5–3.6 mm. in diameter, the subulate teeth 1.8–3 mm. long, all equal or the ventral pair sometimes shortest, the whole becoming papery, ruptured, marcescent; *petals* whitish, rarely


74

pale yellow, drying ochroleucous; *banner* gently recurved through ±45° (further in withering), broadly oblanceolate or rhombic-ovate, shallowly emarginate, 11.6–15 mm. long, 5–6.6 mm. wide; *wings* 10.6–12.9 mm. long, the claws (4.4) 5–6.6 mm., the narrowly oblanceolate, obtuse or subtruncate, gently incurved blades 5.8–6.8 mm. long, 1.9–2.6 mm. wide; *keel* 10.1–12.4 mm. long, the claws 5–6.6 mm., the lunately half-obovate blades 5–6.2 mm. long, 2.2–2.6 mm. wide, rather gently incurved through 85–95 (100)° to the obtuse, sometimes obscurely porrect apex; *anthers* 0.5–0.65 (0.7) mm. long; *pod* erect, sessile, obliquely ovoid or ovoid-ellipsoid, strongly inflated, 1.4–3 cm. long, 8-18 mm. in diameter, rounded at base, contracted distally into a short, triangular-acuminate, laterally flattened beak, shallowly sulcate along the nearly straight ventral and strongly convex dorsal sutures, the thinly fleshy, green, glabrous valves becoming stiffly papery, stramineous or brownish and ultimately dark brown or nearly black, cross-reticulate, either not inflexed or inflexed as a narrow partial septum up to 1 (1.5) mm. wide, the funicular flange narrow, 0.8–1.3 mm. wide; *seeds* ochraceous, pale brown, or olivaceous, sometimes minutely purple-speckled, smooth but scarcely lustrous, (1.4) 2.3–3 mm. long.—Collections: 51 (o); representative: *Sartwell* (from Penn Yan, N. Y.), paratypi (GH, NY, WIS); *F. J. Hermann 9034* (NY); *Sheldon* (from Dalton, Minn.) *in 1892* (NY, WIS); *Fassett 16,680* (NY, WIS); *Moyle 987* (OB, WIS); *Boivin 12,907* (DAO, NY).

Lake shores and banks of streams or in cool ravines, sometimes in light shade of overhanging trees, more rarely on limestone cliff ledges, limestone barrens, or in savanna overlying limestone pavement, local but widely dispersed about the Great Lakes, from eastern Ontario (Carleton and Lanark Counties) and western New York (westward from near Syracuse to the Finger Lakes and Niagara River) to west peninsular Michigan and the west shore of Lake Michigan in Wisconsin; thence interruptedly west to the headwaters of the Mississippi in Minnesota and the Big Sioux and Winnipeg Valleys in southeastern Manitoba and extreme northeastern North Dakota.—Map No. 74.—June to September, the fruit long persisting.

ASTRAGALUS NEGLECTUS (T. & G.) Sheld. in Minn. Bot. Stud. 1: 59. 1894, based on *Phaca neglecta* (overlooked, confused with *A. canadensis*) T. & G., Fl. N. Amer. 1: 344. 1838. —"... throughout the Western part of New York from Onondaga Lake to the Falls of Niagara, *Mr. Cooper! Dr. J. Smith! Dr. Sartwell! Dr. Kinnicutt! Mr. J. Carey!*"—Lectotypus, collected at Lake Onondaga by William Cooper, NY (herb. Torr.)!—*Astragalus Cooperi* (William Cooper, 1798–1864, zoologist and amateur botanist) Gray, Man. Bot., Ed. 2, 98. 1856, an illegitimate substitute, the supposed obstacle, an unspecified *A. neglectus*, apparently non-existent. *Tragacantha neglecta* (T. & G.) O. Kze., Rev. Gen. 941. 1891.

Phaca neglecta fma. *Limonia* (from *Citrus Limonia*, the lemon-tree, the flowers supposedly lemon-yellow) Farw. in Papers Mich. Acad. Sci. 3: 100. 1924.—"Southwest corner of Lapeer Co., No. 6179, June 14."—Holotypus not examined; isotypus, collected at Hadley, Lapeer County, Michigan, GH!—*Astragalus neglectus* fma. *Limonia* (Farw.) Fern. in Rhodora 39: 318. 1937 (*"limonius,"* but the original epithet apparently a substantive in apposition).

The Cooper milk-vetch, *A. neglectus*, is ordinarily a tall, erect, hollow-stemmed plant with the ample, thin-textured foliage of the northern woodlander. The fresh flowers are usually white or greenish-white, fading straw-color when dried, but fma. *Limonia*, indistinguishable as a herbarium specimen, was described as having petals "bright lemon-yellow fading whitish," an unusual sequence of color-change in the genus. The species has been described as mesophytic, but its preference for riparian habitats does not necessarily imply a reliance on copious water at the root. Probably it is the openness of the situation and the porous nature of the strand soils which provide a suitable microhabitat for an astragalus in a primevally forested region. On dry limestone pavements of the Cloche Peninsula in Ontario, *A. neglectus* is represented by a comparatively slender, diffuse or weakly ascending form with narrow stems solid

Map No. 74. The Great Lakes. Range of *A. neglectus*.

to the base and only 2.5–3 dm. tall. Although this ecotype possesses a certain individuality of growth-habit, it does not differ significantly in either flower or fruit.

Within its range of dispersal *A. neglectus* is likely to be mistaken only for *A. canadensis*, with which it is sometimes associated on lake shores in Minnesota and elsewhere. The Canada milk-vetch, much the commoner of the two, is easily recognized by the presence of oblique rhizomes in place of a simple taproot, by the dolabriform hair-attachment, connate stipules, densely many-flowered racemes of nodding flowers, and much narrower, fully bilocular pod.

The nomenclature of the Cooper milk-vetch requires a word of comment, if only because it appears in the two standard floras of northeastern United States current at mid-century under two different names: *A. neglectus* (Fernald, 1950, p. 909) and *A. Cooperi* (Gleason, 1952, p. 417). The latter name was substituted for *Phaca neglecta* in the belief that the epithet *neglectus* was preoccupied in *Astragalus*, probably by *A. neglectus* Ledeb. (ex Steud., Nom., Ed. 2, 1: 162. 1840), but this, so far as I can learn, is a nomen nudum. The species was generally known as *A. Cooperi* from 1856 up to the sixth edition of Gray's Manual in 1890. In 1891 Kuntze revived the epithet *neglecta* in *Tragacantha*, and in 1894 Sheldon, following a principle of priority of epithet regardless of the original genus, made the transfer to *Astragalus*, although he was probably unaware of the true status of *A. neglectus* Ledeb. Meanwhile there had appeared in 1893 an *A. neglectus* Freyn (in Österr. Bot. Zeitschr. 43: 415), ambiguously presented as a binomial (and so taken up by *Index Kewensis*), although intended, as the original text makes very clear, as a subspecies. Freyn's intention is confirmed by the fact that Sommier and Levier, who had collected the typus, listed *A. neglectus* Freyn (in Bull. Soc. Bot. Ital., 1893, p. 526) as a subspecies in this same year. Furthermore Freyn himself later (in Bull. Herb. Bss. 3: 179. 1895) raised the subspecies to the rank of species as *A. neglectus* (Freyn) Freyn. Unless *A. neglectus* Ledeb. can be traced back to a description prior to 1894, it seems that *A. neglectus* (T. & G.) Sheld. is correct and *A. neglectus* (Freyn) Freyn a later homonym.

PUBLICATIONS OF

THE NEW YORK BOTANICAL GARDEN

Standing orders for forthcoming issues of the MEMOIRS and of NORTH AMERICAN FLORA and current subscriptions to journals published by The Garden should be addressed to: Publications Office, The New York Botanical Garden, Bronx, N. Y. 10458. A booklet describing these publications and their prices is available from the same office.

Back issues and reprints of the MEMOIRS and of other serials published by The Garden should be ordered from Stechert-Hafner, Inc., 31 East 10 Street, New York, N. Y. 10003. A descriptive catalog of botanical literature, including all serials and books published by The Garden, may be obtained free by writing to Stechert-Hafner.

Addisonia, colored plates of flowering plants accompanied by nontechnical descriptions: 8 plates to a part, 4 parts to a volume (order from Stechert-Hafner).

Brittonia, official organ of the American Society of Plant Taxonomists, published quarterly.

Economic Botany, official organ of the Society for Economic Botany, published quarterly.

Memoirs of The New York Botanical Garden, scientific papers by members of the staff and collaborators, issued irregularly.

Mycologia, official organ of the Mycological Society of America, published bimonthly.

North American Flora, descriptions of the wild plants of North America, including Greenland, the West Indies, and Central America. 100 parts; now in 2nd series.

The Botanical Review, published quarterly, critical botanical essays.

The Garden Journal, nontechnical articles on botanical, horticultural, and kindred subjects, published bimonthly.

New York Botanical Garden Library
3 5185 00292 3769